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BREEDING SEASON OF THE COTTONTAIL IN CENTRAL MISSOURI

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Two subspecies of cottontail, *Sylvilagus floridanus mearnsi* (Allen) and *S. f. alacer* (Bangs) occur in Missouri. The former is found in the northern part of the state, the latter generally south of the Missouri River. The animals used in this study were killed and trapped almost entirely within a 16-mile radius of Columbia, Boone County, which apparently is within the zone of intergradation of these two races.

During the seventeen months from November 1938 through March 1940, 1,110 cottontails were handled. Of this number, 473 were shot for laboratory study of the reproductive organs. In addition, 637 were trapped, including 254 different individuals and 383 recaptures. A detailed description of trapping technique was given in an earlier paper (Schwartz, 1941).

Data from trapped rabbits applicable to this part of the study were tag number, date, sex, weight, position of the testes in relation to the scrotum, and condition of the mammary glands and hair around the teats (to indicate whether the young were suckling). Pertinent information recorded from dead animals included date, sex, weight, measurements of length (antero-posterior), width (side to side), and thickness (dorso-ventral) of the testes and ovaries, position of testes in relation to the scrotum, and condition of pregnancy or lactation in females. When pregnant, the uterine swellings were measured and the embryos within were measured and preserved in Bouin's fluid.

SEX RATIO

The sex ratio was found to be close to 50:50 in all cottontails collected, both by trapping and by shooting, and in adults as well as in young animals. Each rabbit was counted only once, regardless of its subsequent record. Table 1 shows both sets of data but does not represent all of the rabbits killed since tagged rabbits, whether found dead in the traps or shot, are listed as tagged. The distinction between adult and young animals is discussed by Schwartz (1941).

These data substantiate a general agreement among workers on cottontails that under normal conditions the sex ratio is almost 50:50 (Trippensee, 1936; Gerstell, 1937; Dalke and Sime, 1938; Allen, 1938 and 1939). Departures from this ratio have been found by Trautman (quoted by Trippensee, 1936), Gerstell (1937), and Allen (1939), which may not indicate the actual sex ratio but rather one resulting from different activities of the sexes when collecting was done. For example, they suggest that females tend to "hole up" during inclement weather; rabbits abroad at this time are mostly males, while those taken from holes by the use of ferrets are preponderantly females.

In the present study, the practice of shooting a few rabbits at a time was followed for the most part, so collecting would be scattered throughout the month. On a few occasions, however, as many as forty rabbits were taken in one day in the winter season. The sex ratio was still found to be nearly 50:50 whether the collections were scattered or concentrated; this may indicate

TABLE 1. *Sex ratio of killed and trapped rabbits*

		NO. ♂	NO. ♀	TOTAL	% ♂	% ♀
ADULTS	Killed	200	187	387	51.7	48.3
	Trapped	68	88	156	43.6	56.4
	Total	268	275	543	49.4	50.6
YOUNG	Killed	35	27	62	56.5	43.5
	Trapped	52	46	98	53.0	47.0
	Total	87	73	160	54.4	45.6
ALL RABBITS	Killed	235	214	449	52.5	47.5
	Trapped	120	134	254	47.2	52.8
	Total	355	348	703	50.5	49.5

that the females do not "hole up" so commonly in central Missouri as they apparently do farther north, a point that is supported by field observations.

SIZE OF TESTES

The measurements of testes from 208 adult males are given in Table 2. The lengths of testes are recorded for comparison with the measurements given by other workers, but since what really counts in testis-activity is not so much the length as the actual size, a rough index of the volume indicated by length x width x thickness is also included. The simplest index of increasing or decreasing testicular activity, however, (barring, of course, actual histological examination) is probably the proportional increase or decrease in volume. The smallest volume found (October 1939), therefore, was taken as 1.0, and the corresponding proportions of the other volumes are recorded relative to it in Table 2.

From the fall minimum a steady rise to the maximum in March occurs, followed by a smaller decrease during the next four months and a much more rapid decrease between July and September, when the minimum volume is

reached again. Comparison of the figures between November and March of the successive years, shows an apparently less rapid increase in size during the winter of 1939–1940 as compared with the previous winter. In my opinion this can be explained by the fact that the 1938–1939 collections were made after the middle of each month during this period, whereas all of the 1939–1940 collections were made early in each month.

Trippensee (1936), Dalke (1937), and Hamilton (1940) all noticed that the testes increase in size before and during the breeding season, decreasing again during the late summer and early fall when breeding stops. The size of the testes is correlated with sexual activity in Michigan and New York cottontails (Trippensee, 1934; Hamilton, 1940). Assuming that the same can be said

TABLE 2. *Changes in size of adult testes, by months, November 1938 through March 1940*

MONTH	NO. OF RABBITS	AVERAGE LENGTH IN MM	AVERAGE VOLUME IN MM^3	RELATIVE VOLUME
1938: Nov.	5	18.2	588.8	1.07
Dec.	7	21.7	1,296.4	2.3
1939: Jan.	5	35.8	5,508.0	10.0
Feb.	30	49.9	15,821.1	28.0
Mar.	21	58.8	21,618.8	39.0
Apr.	12	54.9	17,410.1	31.0
May	9	55.1	16,279.1	29.5
June	13	52.1	16,472.0	29.9
July	7	53.7	13,800.0	25.0
Aug.	8	38.7	4,239.5	7.7
Sept.	8	27.1	744.8	1.3
Oct.	9	22.7	549.3	1.00
Nov.	12	32.4	682.4	1.2
Dec.	23	27.6	1,288.7	2.3
1940: Jan.	20	29.5	2,260.0	4.1
Feb.	10	29.3	3,990.5	7.2
Mar.	9	50.8	11,611.6	21.0

of Missouri cottontails, the period of greatest sexual activity among the males is from February through July.

POSITION OF THE TESTES IN RELATION TO THE SCROTUM

Several investigators (Hammond and Marshall, 1925; Trippensee, 1936; Dalke, 1937; Hamilton, 1940) have noticed that the testes migrate from the scrotum into the body cavity proper and they have stated that this occurs at the close of the breeding season. The testes return again to the scrotum with the onset of sexual activity in the early spring. Trippensee (1936) remarks, however, that they may leave the scrotum when the animal is handled and that their position there is not constant.

I found, as did Trippensee, that in any season, the testes may be withdrawn from the scrotum while the rabbit is being handled at the trap or as a result of shock received when the animal is shot. In addition, the testes have been

found occasionally in the scrotum during the winter months when they are small and when sexual activity is at its lowest ebb. It is concluded, therefore, that the presence of the testes in the scrotum is not a reliable indication of sexual activity; also, that the absence of the testes from the scrotum is not merely a fall-winter phenomenon. It can be said, however, that ordinarily the testes are in the scrotum during the breeding season except when the animals are subjected to unusual treatment, and that ordinarily they are withdrawn from the scrotum during the period of sexual quiescence.

SIZE OF OVARIES

In the present study the same measurements of the ovaries were made (length, width, and thickness), and it was found that the changes in size were generally proportional to those seen in the testes; also, the changes occurred at the same

TABLE 3. *Changes in size of adult ovaries, by months, November 1938 through March 1940*

MONTH	NO. OF RABBITS	AVERAGE LENGTH IN MM	AVERAGE VOLUME IN MM^3	RELATIVE VOLUME
1938: Nov.	5	7.0	50.4	1.2
Dec.	8	7.6	54.1	1.3
1939: Jan.	5	8.8	81.6	2.0
Feb.	30	9.0	106.6	2.6
Mar.	22	10.5	158.9	3.9
April	12	10.9	150.5	3.7
May	11	11.0	129.8	3.2
June	6	9.8	95.5	2.3
July	7	9.5	69.2	1.7
Aug.	9	10.3	84.6	2.1
Sept.	10	8.8	66.6	1.6
Oct.	10	7.3	40.2	1.0
Nov.	6	7.3	52.0	1.3
Dec.	18	8.6	67.4	1.6
1940: Jan.	8	7.6	53.7	1.3
Feb.	13	8.9	58.6	1.4
Mar.	19	9.3	93.7	2.3

times of the year. The measurements of length, volume (as indicated by length x width x thickness), and relative volume are given in Table 3.

Figure 1 shows the fluctuation in volume (length x width x thickness) of testes and ovaries during the year. It is realized that the testes actually reach a much greater volume than do the ovaries (39.0 as compared with 3.9), but the degree of fluctuation corresponds closely. Trippensee (1936) found that the average size of the adult ovary was 6.8 x 3.4 x 2.3 mm, with a maximum of 10 x 5 x 3.5 mm. He did not correlate these changes in size with the breeding season.

RESORPTION OF EMBRYOS

During the 1939 breeding season, 43 females containing uterine swellings were killed. Forty contained normal embryos; two contained swellings but no em-

bryos; one was found with only the head of a well-developed embryo that was in the process of disintegration. This last specimen was taken on September 27, and may have been a case of abnormal retention of an embryo of the last litter. This case is somewhat like those found by Castle (1928), in which bones of two embryos were found in utero, and Hinman (1933), in which embryos were found partially or completely resorbed. Both of these reports are on the domestic rabbit.

The two females that contained no embryos mentioned above had five and three uterine swellings respectively; the first was taken in March 1939, the second in August 1939. It is possible that embryos were present though too

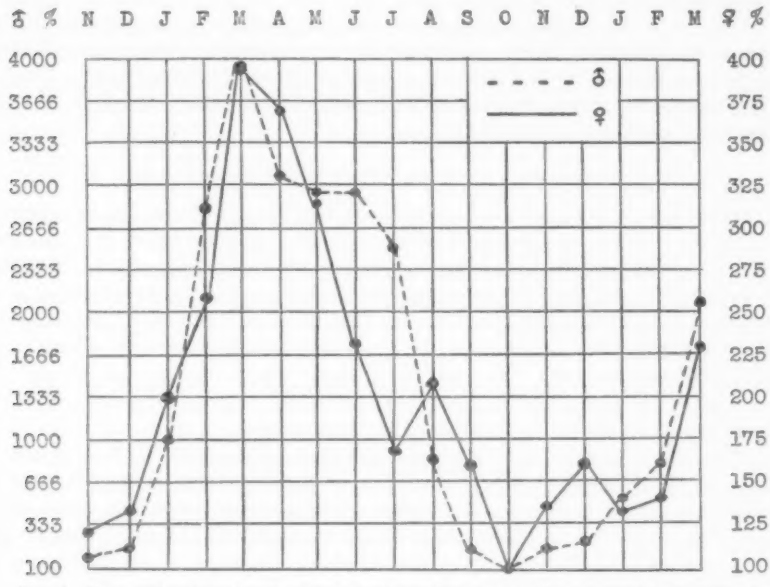

FIG. 1. Fluctuation in volume of testes and ovaries per month, expressed in percentage-increases of length x width x thickness.

small to be seen, but this is considered unlikely because embryos were found in swellings smaller than these. In three females killed on March 15 and March 17, 1939, some of whose uterine swellings contained embryos, others none, no difference was noticed between the size of the swellings containing embryos and those in the same animal that had none. This does not agree with Hammond and Marshall's finding (1925) that all, if any, of the fetuses in the (domestic) rabbit atrophy.

The reason for resorption in these rabbits is unknown, but two suggestions may be offered: It is known that in rats vitamins A, B, and E are necessary for the reproductive functions and normal embryonic development (Evans and

Bishop, 1922; Evans and Burr, 1927; Urner, 1931; Eddy and Dalldorf, 1937). In addition, it has been found that supplementary administration of vitamins will in some cases cause infertile rabbits to become fertile (Hu, Rosahn, and Greene, 1934). Perhaps these March litters suffered from vitamin deficiency before the females could obtain a necessary supply from the new spring vegetation. The one female found with resorbed embryos in August, as Hammond and Marshall (1925) might suggest, may have been nursing a previous litter that prevented further embryonic development.

No previous cases of resorption of embryos have been reported in cottontails. Hammond (1931) suggests that resorption is actually more frequent in domestic than in wild rabbits.

The size of the uterine swellings was found to be directly proportional to the size of the embryos within. Until the embryo reached a crown-rump length of 30 mm, the uterine swelling was round. As the embryo increased in length from 30 mm to 110 mm the swelling increased proportionally in length, although the width remained about 30–38 mm.

BEGINNING AND END OF THE BREEDING SEASON

The 1939 and 1940 breeding seasons in central Missouri began about the first of March. Of the 43 females containing uterine swellings taken in 1939, the earliest records are for March 15 and 17 and all the embryos on these dates were from 10 to 14 days old (*cf.* discussion of gross external embryology below). The last females containing embryos in 1939 were collected on August 23 and 26, except the female containing the abnormal head noted above, which was killed on September 27. The embryos of these August females were 16 and 17 days old. Allowing 28 or 30 days for gestation (*cf.* below), these litters should have been born during the first week in September.

Thus, if we consider that the breeding season begins with the first matings and ends with the birth of the last litters, it extends from the first of March to the first week in September in Missouri. In the case of *S. f. mearnsi*, Trippensee (1936) says the breeding season begins in mid-January, Allen (1938) in February, and Hamilton (1940) about March 1. Hamilton states that the onset of the breeding season may be delayed by inclement weather, but in spite of the severe cold in Missouri during January and February 1940, the onset of the breeding season did not seem to be delayed. Four of the 19 females killed in March 1940 were pregnant; this is a smaller proportion than in March 1939, when 17 of the 22 females killed were pregnant; but, as pointed out above, the March 1939 collections were made considerably later in the month than the March 1940 collections.

Trippensee (1936), Allen (1938), and Hamilton (1940) agree that the season ends some time in August, although two later pregnancies are recorded. Dalke (1937) reports that he found pregnant females of *S. f. mallurus* from April 10 through August 10, and recently on March 15 (unpublished data), although he does not specify the extremes of the breeding season.

NUMBER OF LITTERS PER YEAR: REGULARITY OF PRODUCTION

It is necessary to discuss here some phases of the reproductive activity of the domestic rabbit, studied by Hammond and Marshall (1925) as no comparable work has been done on the cottontail.

After the period of anestrus, four possible sequences of events occur: (1) Following coitus, ovulation occurs in about ten hours and fertilization follows. The ruptured follicles in the ovaries are transformed into corpora lutea, which increase in size as the embryos develop. It is the presence of these corpora lutea that prevents the development of additional follicles and further ovulation if there is coitus during pregnancy. After parturition, the corpora lutea begin to decrease in size and ovulation may occur after coitus at this time. The period of pregnancy occupies about 32 days in the domestic rabbit.

(2) Suckling does not prevent ovulation after coitus in the early stages of lactation, but does so from the 8th day on in the case of does suckling large litters. From the 12th day on, all does refuse to copulate, coming into heat again only when the young have been weaned. Lactation ends about the 40th day after parturition.

(3) Sterile coitus or orgasm produced by does mounting each other will cause ovulation, and this is followed by pseudopregnancy, culminating the 17th day (Templeton, 1940) or about the 16th to 19th day (Hammond and Marshall, 1925) with the secretion of milk and often with the building of a nest and the plucking of fur to line it. Ovulation does not occur, however, as a result of coitus during pseudopregnancy, because of the corpora lutea present; after the 16th to the 19th day, these begin to atrophy and rupture of the follicles occurs if coitus takes place from this time on.

(4) In the absence of a mate, a doe may remain in heat for several weeks at a time; but if does are kept unmated for as long as a month, especially at the height of the breeding season, they are likely to be sterile as indicated by mating. Luteal tissue is frequently developed in the follicles and prevents rupture of other ripe follicles (Hammond, 1931).

Thus, Hammond and Marshall found that if a female is not mated within 8–12 days after parturition, she will not have a positive mating for a month. If, after parturition, she is mounted by a doe and ovulates, she will not conceive for at least another 16–19 days, because of pseudopregnancy. If she is unmated at the beginning of the breeding season, she may, theoretically, be mated one or two or three weeks later. It must be remembered that these observations were made on the domestic rabbit.

The data collected in this study indicate that most female cottontails are impregnated about March 1 and that thereafter a monthly periodicity is set up. That is to say, there seem to be successive periods, a week or ten days in extent, coming at about one-month intervals during the breeding season, at which mating probably occurs as indicated by the litters that are born approximately one month later.

Figure 2 shows the date on which each pregnant female was killed in 1939,

marked by the beginning of each horizontal line. The end of each line marks the date at which the young would have been born, as determined by the size of the embryos (described below). The figure shows a definite periodicity early in the season, becoming somewhat less regular as the season progresses—perhaps because of the small number of pregnant females taken in July and August, perhaps because of irregularities due to pseudopregnancy and sterility. There appear to be six possible "breeding periods" within the breeding season, and theoretically six litters could be produced by one female in a season.

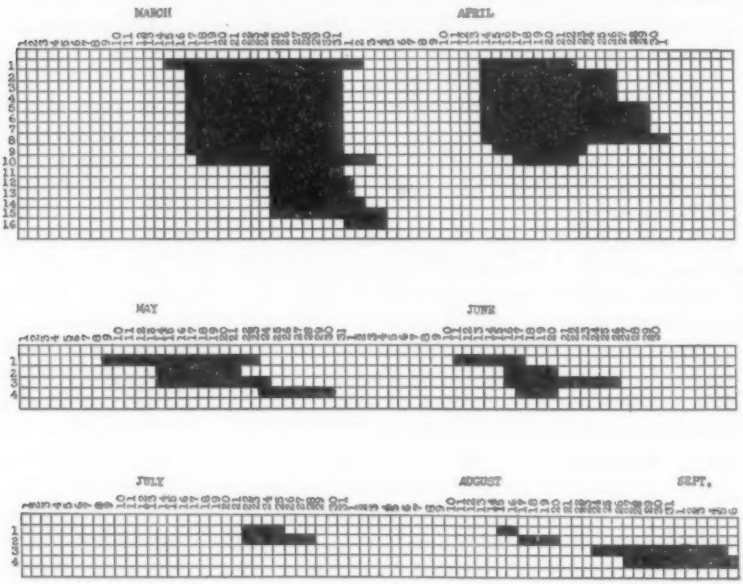

FIG. 2. Periodicity in the production of litters during the 1939 breeding season. The beginning of each horizontal line represents the date on which each pregnant female was killed and the end of each line indicates the approximate time of birth of her embryos.

Others authors agree that breeding occurs during the spring and summer months (Trippensee, 1936; Dalke, 1937; Allen, 1938; Hamilton, 1940), but they do not discuss the possibility that the successive litters may appear at fairly regular intervals in the population as a whole.

NUMBER OF LITTERS PER FEMALE PER YEAR

One way in which it may be possible to estimate the average number of litters per female per year is by means of a proportion: The ratio of pregnant females to the entire number of females taken represents the ratio of pregnant females to all females in the population; therefore, a corresponding fraction of six (the maximum number of litters probably born during a year) represents the average

number of litters born by any one female. This method, using the small number of females taken in the present study, will not give entirely reliable results, but it is presented with the idea that it can be used with larger collections in the future.

Table 4 shows the total females and the pregnant females taken in the successive "breeding periods." Multiplying each total by the percentage and dividing the sum of these products by the total number of females gives the average percentage corrected for the different numbers of females taken in the different months; the result is 63.3 per cent. Theoretically, then, the average number of litters per female per year is .633 x 6 (the maximum), which is 3.8 litters.

This figure tends to support the views presented by other investigators, but before it can be stated with certainty there must be larger collections during every month of the breeding season so that the sample of the population will be more reliable.

It is stated that a female may have at least two litters per year (Hamilton, 1940), because females have been found both pregnant and nursing. In the present study, eleven such females were taken; April, one; May, three; June, two; August, five. Haugen (1940) handled four females that produced four litters each; he believes that three or four litters a season are common in Michigan (quoted by Hickie, 1940).

TABLE 4. *Total females and pregnant females taken*

PERIOD	TOTAL FEMALES	PREGNANT FEMALES	% PREGNANT
1	22	17	77
2	11	10	91
3	11	4	36
4	6	4	67
5	7	2	28
6	9	5	55

The following number of litters per female per year are mentioned by other authors: four (Bedell, 1934); three or four (Leopold, 1936); two common, four probable (Trippensee, 1936); two or three (Dalke, 1937); two certainly, three probably (Gerstell, 1937); two (Allen, 1938); and five as a maximum (Hickie, 1940.)

NUMBER OF YOUNG PER LITTER

In the 40 pregnant females taken in 1939 (not counting the two that contained uterine swellings but no embryos, and the one with only the abnormal head) the average was corrected for the different numbers taken in different months; the result was 4.4 embryos per female. The maximum was 8; the minimum was 1. This is to be compared with results of other investigators: 5.04 (Trippensee, 1936); 5.2 (Dalke, 1937); 5.0 (Gerstell, 1937); 5.1 (Allen, 1938); 4.5 (Hamilton, 1940).

Dalke (1937) reported a slight increase in the number of embryos per female from April 27 through June 5, as compared with the rest of the season. In the present study a similar increase was noted. The average number of young per litter in each monthly "breeding period" of the 1939 breeding season was as follows: During the first period (*cf.* Fig. 2), 3.3; second, 5.7; third, 6.7; fourth, 3.7; fifth, 3.5; sixth, 4.5. Hammond (1931) found that in the domestic rabbit the number of young per litter born by young does increased after the first litter to about the third or fourth litter. Therefore, it is quite possible that the number of young in the first-period litters may be smaller than the number in subsequent litters because young does probably bear their first litters at that time.

NUMBER OF YOUNG PER FEMALE PER YEAR

Using the limited number of cases obtained in the present study, an average of 4.4 embryos per litter (assuming that all are born, which may not be the case) and an average of 3.8 litters per year would mean an average of 16.7 young per female per year. Probably the actual figure is somewhat lower because of prenatal mortality. This, too, must be studied in a much larger number of cases.

Leopold (1936) thinks that the number of young per female per year is from 12 to 14 or perhaps higher. Gerstell (1937), however, was unable to obtain an average of as many as four young per doe under conditions of artificial propagation, when the animals were kept in enclosures. Hickie (1940) states that the annual increase should be 15 or 20 young per female, with 25 as a maximum.

GROSS EXTERNAL EMBRYOLOGY

In the forty sets of embryos taken in the present study, the lengths (crown-rump lengths in all but the few very early stages) ranged from 3 mm to 110 mm, the length at birth. From the standpoint of gross external morphology, embryos of similar lengths were in similar stages of development and there was a close correspondence between the features of cottontail embryos and those of domestic rabbit embryos of the same dimensions, as given by Minot and Taylor (1905). Because the gestation period in the cottontail is two or three days shorter than that in the domestic rabbit (Hammond and Marshall, 1935; Dice, 1929 and 1933; Leopold, 1936; Nelson, quoted by Trippensee, 1936; and Gerstell, 1937), the exact age, to the day, of each embryo cannot be determined. It can be determined within a day or two, however, with some accuracy.

To explain the manner of estimating the age of an embryo, Table 5 lists the embryos taken and their lengths. The stages up to 29 mm could be placed fairly accurately in age-groups following the work of Minot and Taylor (1905); they give the ages of earlier stages and state that the 29 mm embryo is twenty days old. This is in the domestic rabbit whose gestation period averages 32 days. The development of the cottontail during the remaining third of the gestation period could be divided roughly into eight general periods and the age

of the embryos estimated within a day or two. For more accurate age-size data, many more embryos should be studied or, better, cottontails should be reared and bred in captivity. So far, however, the latter has not been possible except under the semi-captive conditions used by Bedell (1934) and Gerstell (1937).

The single 3 mm embryo was badly damaged and all of the desired observations could not be made. It is obvious that no limb buds are present at this stage, however. The eye-primordium is represented by a large optic vesicle; the otic vesicle is conspicuous; somites are visible; the brain and spinal cord are easily seen; and the heart is conspicuous externally. This description corresponds to that of the 3.4 mm stage of the domestic rabbit shown by Minot and Taylor (1905), which was said to be 9.5 days old. The embryo is fairly straight.

Plate I (Figures A–H) illustrates embryos of the cottontail between the 4–7 mm stage and the 110 mm (birth) stage. Descriptions of their gross external anatomy are as follows:

4–7 mm stage (Fig. A).—This is represented by 28 embryos. Both anterior and posterior limb buds are present; the optic vesicle is still unpigmented; a

TABLE 5. *Lengths and numbers of embryos studied*

LENGTH (MM)	NUMBER	LENGTH (MM)	NUMBER
3	1	48– 57	7
4– 7	28	58– 67	15
8–13	30	68– 77	7
14–19	34	78– 87	1
20–27	11	88– 97	2
28–37	20	98–110	2
38–47	16		

small otic vesicle can be seen; and the nose is represented by a deep pit. Two gill arches, the mandibular with its maxillary process and the hyoid, are present; somites are visible in the back and tail regions; the heart is still evident externally; and the body is greatly curved. The 6 mm stage of the domestic rabbit agrees closely with this description and is 11.5 days old (Minot and Taylor, 1905).

8–13 mm stage (Fig. B).—Thirty embryos were obtained in this group. The limbs have increased in size and consist of two parts; these are the arm or leg and the "paddle," which will become the hand or foot. The optic vesicle is pigmented but is not distinctly separated from the face; the external ear is represented as a ridge on the hyoid arch. The nose and mouth are well formed, the maxillary process of the mandibular arch forming the upper jaw, the lower jaw is formed by the remainder of the mandibular arch, with the mouth an opening between them. Somites are still visible in the back and tail regions, and the heart is visible as a bulge under the head. The milk-line is appearing and the genital tubercle is present as a bulge. The domestic rabbit of 13.5 days (Minot and Taylor, 1905) compares closely with this description.

14–19 mm stage (Fig. C).—Thirty-four embryos were in this group. The description of the 14–19 mm embryos fits closely the description of domestic rabbit embryos 16 days old (Minot and Taylor, 1905). In this stage, the hands

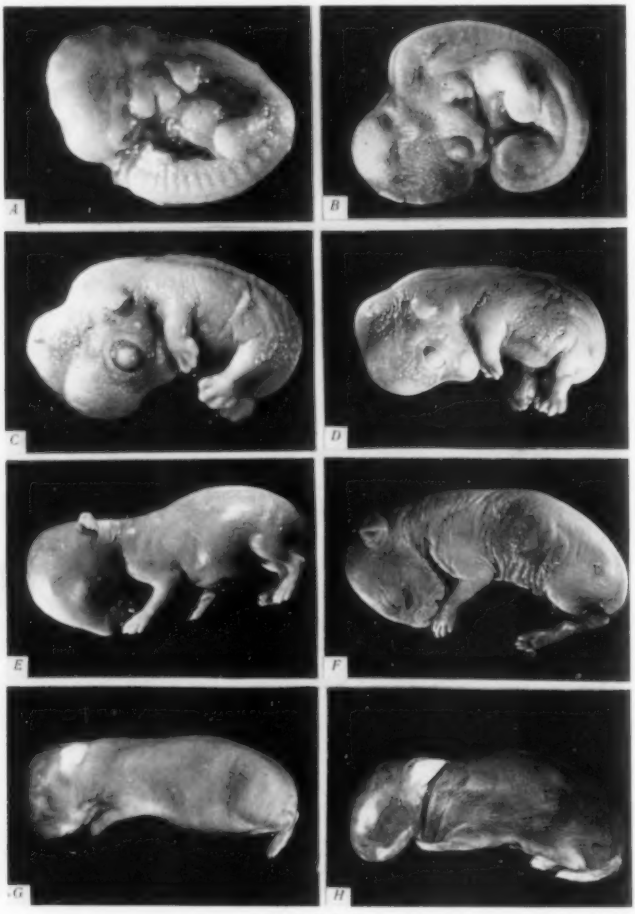

PLATE I

These photographs, taken by the author, were from preserved material. A.—7 mm embryo; B.—13 mm embryo; C.—18 mm embryo; D.—22 mm embryo; E.—37 mm embryo; F.—49 mm embryo; G.—85 mm embryo; H.—100 mm embryo.

and feet show the beginning of digits, the eye is clearly marked, and the eyelids are forming. The external ear has become a small flap, and the tail measures one millimeter in length. Somites are seen only in the tail and the heart is no

longer visible externally. The mammae are barely visible and the genital tubercle can also be seen. Hair follicles of the whiskers are beginning to appear above the eye and on the nose and cheek. The embryo continues to straighten out from the greatly curved position of the 4–7 mm stage.

20–27 mm stage (Fig. D).—Eleven embryos represent this stage. Separate digits are visible on the hands and feet, five on the anterior, four on the posterior appendages. The eyelids are closing over the eyes. The ear measures one millimeter in length and the tail has increased to 2 mm. Somites are no longer visible externally, and the most conspicuous change is that of the hair follicles, which appear in large numbers all over the surface of the face and trunk. The embryo is much longer in the antero-posterior axis. This describes also the domestic rabbit of the 21 mm stage, 17 days old, shown by Minot and Taylor (1905).

28–37 mm stage (Fig. E).—Twenty embryos were found at this stage, corresponding to the 29 mm stage in the domestic rabbit, 20 days old (Minot and Taylor, 1905). Claws are present on the digits; the eyes are closed. The ear-length has increased to between 2 mm and 3 mm; the length of the tail to between 3 mm and 4 mm.

38–110 mm stages.—These remaining stages were represented by 50 embryos, but no comparable ones were described in the domestic rabbit. Three embryos were selected to show the progressive stages of development: 49 mm stage, (Fig. F); 85 mm stage (Fig. G), and 100 mm stage (Fig. H). In all of them the claws are well formed. Whiskers appear on the nose, above the eyes, and upon the cheeks in the two earlier embryos (49 mm and 85 mm), becoming longer as the birth-stage is approached. From 65 mm on, pigmentation is pronounced, the embryo being darker on the dorsal and lateral surfaces, lighter on the ventral. At the stage of birth the body is well furred. In these stages, it is possible to tell the males externally by the presence of small scrotal swellings around the genital tubercle; these are absent in females. Dissection verifies this sexual distinction. At the 110 mm stage, the ears have reached 12 mm in length, the tail 7 mm, and the hind foot 19 mm. Embryos showing this development correspond to the birth-stage described by Trippensee (1934).

WEIGHT

Before it is possible to draw definite conclusions as to the breeding season of the cottontail, it is necessary to have some basis for distinguishing adult from young rabbits. It is not difficult to distinguish the extremes, but as they approach each other, the line of demarcation is hard to find. At this intermediate level, the weight seems to be the only key to this distinction (Schwartz, 1941). On this basis, it takes 4.5 to 5 months for a cottontail to reach the minimum adult female weight of 2 pounds 7 ounces (963 grams), or the minimum adult male weight of 2 pounds (907 grams).

Except in January, adult females are heavier than adult males. The lowest average for females is 2 pounds 7 ounces (1,122 grams) in January, which increases to a maximum of 3 pounds 3 ounces (1,446 grams) in June, then de-

clines again to the January level. The maximum for males is 2 pounds 11 ounces (1,218 grams), also in June, although the weights during the rest of the year fluctuate between 2 pounds 5 ounces (1,058 grams) and 2 pounds 9 ounces (1,183 grams). Table 6 shows the average weights of males and females from November 1938 through March 1940, based upon 388 males and 402 females.

If this variation in weight were due to food alone, it might explain why the peaks of both male and female weight were reached in June, but not why the females lost more weight during the winter. Perhaps the weight may be correlated also with breeding activity, since it is known that females undergo an increase in weight during pregnancy and lactation and thus would be expected to show a differential increase in weight during that part of the year at least. This may also explain why the weight-differences between the sexes are not

TABLE 6. *Average weights in grams of males and females, by months, November 1938 through March 1940*

MONTH	MALE	FEMALE
1938: Nov.	1,110	1,218
Dec.	1,125	1,242
1939: Jan.	1,133	1,122
Feb.	1,093	1,188
Mar.	1,124	1,227
Apr.	1,058	1,189
May	1,166	1,371
June	1,222	1,446
July	1,183	1,309
Aug.	1,087	1,277
Sept.	1,144	1,297
Oct.	1,122	1,224
Nov.	1,150	1,229
Dec.	1,167	1,248
1940: Jan.	1,110	1,105
Feb.	1,134	1,137
Mar.	1,221	1,299

correlated with differences in taxonomic measurements, which are identical in males and females.

From Allen's data (1939), it can be seen that the average weights of *S. f. mearnsi* are higher than those of the cottontail in Missouri but in both cases the females average higher than males. Dalke (1937) reports an increase in weight from November to February in both males and females of *S. f. mallurus* that does not correspond to the Missouri cottontails, which weigh less during these months.

ACKNOWLEDGEMENTS

This study was carried on under the direction of Dr. Rudolf Bennitt, Professor of Zoology, and I wish to express my appreciation to him. Thanks are due to my wife, Dr. Elizabeth Reeder-Schwartz; Dr. Paul D. Dalke, Asso-

ciate Biologist, U.S. Fish and Wildlife Service; and Messrs. I. C. Adams, Jr., and Irby Bunding, graduate students at the University of Missouri. The Missouri Cooperative Wildlife Research Unit provided equipment and transportation.

SUMMARY

1. The sex ratio in 703 rabbits collected by trapping and shooting was 50.5 males to 49.5 females.

2. The testes increase in size and volume prior to the breeding season, the greatest size (March) being 39 times as large as the smallest size (October).

3. The presence of the testes in the scrotum is to be taken as a general but by no means invariable indication of breeding activity. The testes may leave the scrotum under conditions of shock, even during the breeding season, and they may be in the scrotum in winter.

4. The ovaries increase in size and volume prior to the breeding season, the greatest size (March) being 3.9 times as large as the smallest size (October).

5. Total resorption of embryos was found to occur in two instances. In three instances some of the embryos of the same female had been resorbed, others had not.

6. Mating begins about March 1 and continues until early August. The end of the breeding season is in early September, when the last litters are born.

7. There may be six "breeding periods" in each breeding season, occurring in March, April, May, June, July, and August.

8. On the basis of present data, there are 3.8 litters per female per year in the population as a whole.

9. The average number of young per litter is 4.4.

10. The average number of young born per female per year is 16.7.

11. Embryonic stages from 3 mm to 110 mm (birth stage) are described.

12. Females average heavier in weight than males: female June maximum 1,446 grams; January minimum 1,122 grams; male June maximum of 1,222 grams and minimum of 1,058 grams. A definite period of increase and decrease in the male such as in the female is lacking.

13. From 4.5 to 5 months are required for a young rabbit to reach the minimum adult female weight of 963 grams or the minimum adult male weight of 907 grams.

LITERATURE CITED

ALLEN, D. L. 1938. Breeding of the cottontail rabbit in southern Michigan. Amer. Midl. Nat., vol. 20, pp. 464–469.

——— 1939. Michigan cottontails in winter. J. Wildlife Mgt., vol. 3, pp. 307–322.

BEDELL, C. S. 1934. Rearing cottontails in captivity. Game Breeder and Sportsman, vol. 38, pp. 183, 196–197.

CASTLE, W. E. 1928. The fate of unborn rabbit embryos. Amer. J. Anat., vol. 42, pp. 399–400.

DALKE, P. D. 1937. A preliminary report of the New England cottontail studies. Trans. Second No. Amer. Wildlife Conf., pp. 542–548.

DALKE, P. D., and P. R. SIME. 1938. Home and seasonal ranges of the eastern cottontail in Connecticut. Trans. Third No. Amer. Wildlife Conf., pp. 659–669.

DICE, L. R. 1929. An attempt to breed cottontail rabbits in captivity. Jour. Mamm., vol. 10, pp. 225–229.

——— 1933. A correction concerning the species of cottontail that bred in captivity. Jour. Mamm., vol. 14, p. 162.

EDDY, W. H., and G. DALLDORF. 1937. The avitaminoses. Williams & Wilkins, Baltimore, pp. 3–321.

EVANS, H. M., and K. S. BISHOP. 1922. On the relation between fertility and nutrition. II. The ovulation rhythm in the rat on inadequate nutritional regimes. Jour. Metab. Res., vol. 1, pp. 335–356.

EVANS, H. M., and G. O. BURR. 1927. The antisterility vitamine fat-soluble E. Mem. Univ. California, vol. 8, pp. 1–173.

GERSTELL, R. 1937. Management of the cottontail rabbit in Pennsylvania. Pennsylvania Game News, vol. 7, no. 12, pp. 6–7, 27, 30; ibid. vol. 8, no. 1, pp. 15–19; no. 2, pp. 8–11, 32; no. 3, pp. 12–15, 26.

HAMILTON, W. J. JR. 1940. Breeding habits of the cottontail rabbit in New York state. Jour. Mamm., vol. 21, pp. 8–11.

HAMMOND, J. 1931. The processes of reproduction in the rabbit. Zeitschr. Pelztier-u. Rauchwarenk., vol. 3, pp. 56–63.

HAMMOND, J., and F. H. A. MARSHALL. 1925. Reproduction in the rabbit. Oliver and Boyd, London, pp. vii–xii and 1–200.

HICKIE, P. 1940. Cottontails in Michigan, Game Division, Michigan Department of Conservation, pp. 14–15.

HINMAN, R. B. 1933. Foetal resorption in animal husbandry. Am. Soc. Animal Prod. Rec. Proc. Ann. Meet., vol. 25, pp. 282–283.

HU, C. K., P. D. ROSAHN, and H. S. N. GREENE. 1934. Observations on vitamin treatment of reproductive abnormalities in the rabbit. Proc. Soc. Exp. Biol. & Med., vol. 31, pp. 1010–1012.

LEOPOLD, A. 1936. Game Management, Charles Scribner's Sons, 481 pp.

MINOT, C. S., and E. TAYLOR. 1905. Normal plates of the development of the rabbit (*Lepus cuniculus* L.). Normentafeln zur Entwicklungsgeschichte der Witzbeltiere. Keibel, Heft 5, Gustav Fischer, Jena, pp. 1–27.

SCHWARTZ, C. W. 1941. Home range of the cottontail in central Missouri. Jour. Mamm., vol. 22, pp. 386–392.

TEMPLETON, G. S. 1940. Pseudopregnancy in domestic rabbits. Wildlife Circular 4, U. S. Fish and Wildlife Service, pp. 1–13.

TRIPPENSEE, R. E. 1934. The biology and management of the cottontail rabbit. Univ. Michigan School of Forestry & Conservation, unpublished thesis, pp. 1–217.

———. 1936. The reproductive function in the cottontail rabbit (*Sylvilagus floridanus mearnsii* (Allen)) in southern Michigan. Proc. No. Amer. Wildlife Conf., pp. 344–350.

URNER, J. A. 1931. The intra-uterine changes in the pregnant albino rat (*Mus norvegicus*) deprived of Vitamin E. Anat. Rec., vol. 50, pp. 175–187.

Missouri Conservation Commission, Jefferson City, Missouri.

RING-TAILED CATS (*BASSARISCUS ASTUTUS*): THEIR GROWTH AND DEVELOPMENT

By William B. Richardson

The life history of the ring-tailed cat has been virtually uninvestigated and the new-born young have not been previously described. With a view to filling this gap in mammalogical knowledge, studies were made of these animals during 1940. This work, a contribution from the Archbold Expeditions of The American Museum of Natural History, was commenced at our biological station 18 miles east of Tucson, Arizona, at the base of the Rincon Mountains, and was completed in New York. I am indebted to Mr. Richard Archbold, who has made this study possible, and to Dr. Charles T. Vorhies for his care of, and subsequent information on, two young ring-tails left with him.

MATERIAL AND METHODS

During the early part of March three adult female ring-tailed cats were obtained and each housed in a large outdoor cage with a mate. Each cage was supplied with a nest box, and it was in these boxes that five young were born, four in one litter and one in another. On August 4 our biological station was disbanded, and I returned to New York, bringing a young male and female ring-tail with me. In New York they were housed in a large box cage with sawdust floor, a shelf, and ample room for exercise. As had been the custom, they were fed each evening a mixed diet of fruit, vegetables, meat, milk, and water. The following is a list of food eaten by the adults and/or the young:

Native foods: Prickly pear fruit, saguaro fruit, rats and mice, birds, lizards, grasshoppers, round-tailed squirrels. However, a rock squirrel, *Citellus variegatus grammurus*, which was in the adults' cage for several weeks, was not killed by them.

Non-native foods: Meat scraps of all kinds (both cooked and uncooked), dog food (canned), fish, apples, peaches, pears, tomatoes, carrots, string beans, peas, corn, cauliflower, celery, lettuce, spinach, swiss chard, romaine, oat meal (uncooked), milk.

The five young were weighed and measured in the late afternoon every other day for a period of 61 days. Measurements were continued on the two young taken to New York, but weights were discontinued and not resumed until some time later (see graph). The weights were made on a balance scale accurate to one-tenth of a gram. A steel rule was used in measuring the tail, head, and head plus body lengths, while dial calipers were used for other measurements. Measurements were made as follows: head and body from tip of rhinarium to anterior lip of anus; tail from tip to the angle made with body; head from tip of rhinarium to occiput; ear from tip to notch; hind foot from heel to end of middle claw.

On the original graph each young was plotted individually, but with reduction the proximity of the lines made it impossible to distinguish one line from the other. Thus, each line as it appears in the two graphs (figs. 2 and 3) is

virtually an average of the five young for the first 61 days and of the two young for the remainder of the period.

One of the two ring-tails left with Dr. Vorhies was prepared as a specimen on November 1, at the age of 152 days. The weights and measurements that he made are designated on the graph as with a circle dot.

With increased activity the young became more and more difficult to hold while measuring. By the time they had reached the age of 78 days, it became necessary to administer ether. Small doses were given, just enough to quiet them during the short period of time the measurements were taken.

SEASON OF REPRODUCTION

The first litter of four was born June 3. Nine days later another female gave birth to a single young; the third female had no young. Two other females were collected, one May 23, and the other May 26, and prepared as

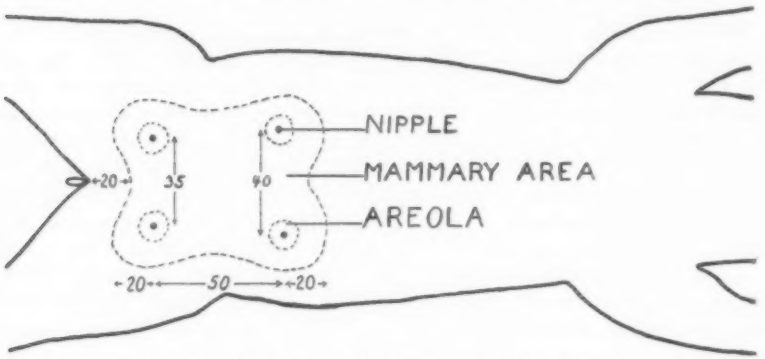

FIG. 1. Diagram of a lactating ring-tailed cat indicating position of mammary glands and mammary area. Figures given represent distance in millimeters.

study skins. The latter had no embryo nor was she suckling young; however, the former was lactating and from the appearance of her large, coarse nipples, appeared to have been suckling young for a week or more. The diagram (fig. 1) shows the area and position of her mammae. These records would indicate that in the vicinity of Tucson, Arizona, parturition takes place in May and June.

My findings agree with those of Grinnell, Dixon, and Linsdale (1937, p. 178), who state, "The majority of the young are believed to be born in May and June . . . ."

ACTIVITY OF THE ADULT

No information was obtained on the period of gestation, for each pair was continually together, eating out of the same pan, sleeping in the same nest box. No signs of courtship or breeding were observed. It was not until three or four days before the young were born that each female showed signs of

hostility toward the male. She drove him from the nest box and into an adjoining one, where he remained until the young were born. Fearing infanticide, I removed the male from the cage containing the new-born young. There was no preparation of the nest box by the expectant mother for the young to come. The box apparently suited her, for she made no effort to clean it out or change the nest material of cotton lint, which had previously been supplied.

The female to whom the four young were born was observed on the evening of June 2. There was nothing unusual about her actions except for her antagonism toward the male, as has been mentioned. At 8 a.m. on June 3, the cages were examined as usual. Squeaking from the nest announced that young were present. Apparently they had arrived some time that morning, for the female was still swollen and bloody about the genital area, and the young had one to two inches of partially dried umbilical cord attached to the naval, as well as spots of amniotic fluid clinging to their short pelts.

NEW-BORN YOUNG

The young were thinly covered with a whitish hair 3 mm long on the back, 1 mm on the belly. Cream colored skin showing through gave the young a fuzzy, nude appearance. As the animals grew, the fuzz grew out forming the guard hairs. With a hand lens one could observe a few black hairs scattered among the lighter colored ones of the body; they were commoner about the head. On the tail, although short, they were found exclusively on the dark incomplete bands. At this early age the dark tail bands were made conspicuous because of the pigmented skin rather than by the short dark hair. Although the eyes were closed, the bulge of the eyeball and the slightly pigmented lids indicated their position. The small fleshy pinna of the ear was nearly erect and covered with short hair the same color as that of the body. There was, however, no visible opening of the auditory canal. As compared with the adult, their muzzles were stubby, with a broad mouth, a large tongue that curled up at the lateral edges, and with no teeth. The rhinarium was blackish. The infant had a short tail, fleshy at the base, which gradually tapered and made a vertical curl forming nearly a complete loop in the distal fourth. The feet and toes were weak and chubby, with small, sharp, extruded, but not retractable claws. The vibrissae were short, the longest measuring 3.5 mm. Varying in length between one and two inches, the umbilical cord remained attached to the young for the first two or three days, then dropped off, leaving a small scar. The dorsal surface of the young had a scaly appearance from the flaking off of the epidermis. The voice was a metallic squeak, which was repeated frequently when suckling and almost continually when the young one was detached from the mother. The sweetish musk odor of the infants was similar to that of the mother, and may have resulted from their close contact. The feces were soft, dark brown or greenish brown in color.

The activity of the young was limited. They could right themselves when turned on their backs, continually struggling to turn over until successful. Locomotion was difficult and was accomplished principally with the front feet.

PLATE 1

UPPER LEFT: Lateral view of day old young. MIDDLE LEFT: Head and forefeet of ringtail ten days old. This photo was taken while the animal was squeaking. LOWER LEFT: Young 41 days old being held by the nape of the neck while it remains relaxed. UPPER RIGHT: Head and forefeet of 41 day old young. Note drooped ears and small eyes as compared with older animals. MIDDLE RIGHT: Young 53 days old. Note adult-like facial marking, erect ears, and bulging eyes. LOWER RIGHT: A litter of young 53 days old.

The hind feet were dragged, only spasmodically making a simultaneous kick backward. The belly could not be raised off the ground. Touching the young with one's finger stimulated them to move, usually toward the stimulus. Ac-

companying the movement was the swaying of the head from side to side and a sucking action of the mouth, the type of action used in searching for the mother's mammae. The long neck gave them free motion of the head, which aided them in gaining the mammae from a prone position. There was no attempt to turn onto their backs (as is found in the response of young wood rats) when cotton was pressed against their dorsal surface. Stroking of the vibrissae produced no effect, it was entirely disregarded. This description is based on five young.

OBSERVATIONS ON THE FEMALE AND FOUR YOUNG

The first day the female seemed nervous and excited but she soon quieted down to be an excellent mother. The first afternoon when the young, which had been removed for weighing and measuring, were returned to the nest box, the female was observed nursing them. She was in a hunched sitting position with her hind legs spread, and with her front legs propping up the fore part of her body. Three of the young were suckling while the fourth was in search of a nipple but was carrying on his activities too far forward. In suckling the nipple was taken well down in the throat with the lips and tongue pressing against the belly of the mother. The female was observed to assume several different nursing positions varying from lying on her side to the above mentioned posture. Whatever her posture, she was always careful to have the mammae available to the young. On two occasions she appeared to push the young deliberately with her front paw toward the mammary region. To find the nipple the young searched at random, swinging the head from side to side, pawing, clawing, and poking their noses into every nook and corner until the goal was reached. Accompanying this search was the repeated metallic squeak not only from the individual in search of the nipple but from those attached that were being trampled. On several occasions one young was observed to crowd another off and take possession of the nipple. The young, while suckling, were in a prone position and were usually braced to maintain that position. Later the female was observed licking the anal region of the young. This probably stimulated voiding, as it does with wood rats and grasshopper mice. The excrement of the young was consumed by the parent.

Not infrequently when the female was disturbed during the day, she left the nest box carrying one of the young with her and remaining out until her nervousness subsided. The female usually carried the young by grasping the whole shoulder region with her mouth. Sometimes she seized the head or belly region and transported the animal in this seemingly clumsy fashion. She rarely grasped the skin of the neck or shoulder as does a cat. The young relaxed while being carried, but occasionally their claws would catch on protruding objects, hampering the movements of the female.

YOUNG OF 35 DAYS

The young were fully haired with a fuzzy juvenile pelt. Dorsally the color of the head and body was dark grey, with a grizzled effect produced by the

light tipped guard hairs. The maximum length of the guard hairs in the middle of the back and at the base of the tail measured 21 mm, while the underfur measured 9 mm. Ventrally the light grey of the basal hairs was partially obscured by the whitish hair tips, giving that region its predominant color. In the middle of the belly the guard hair measured 11 mm in length, the underfur

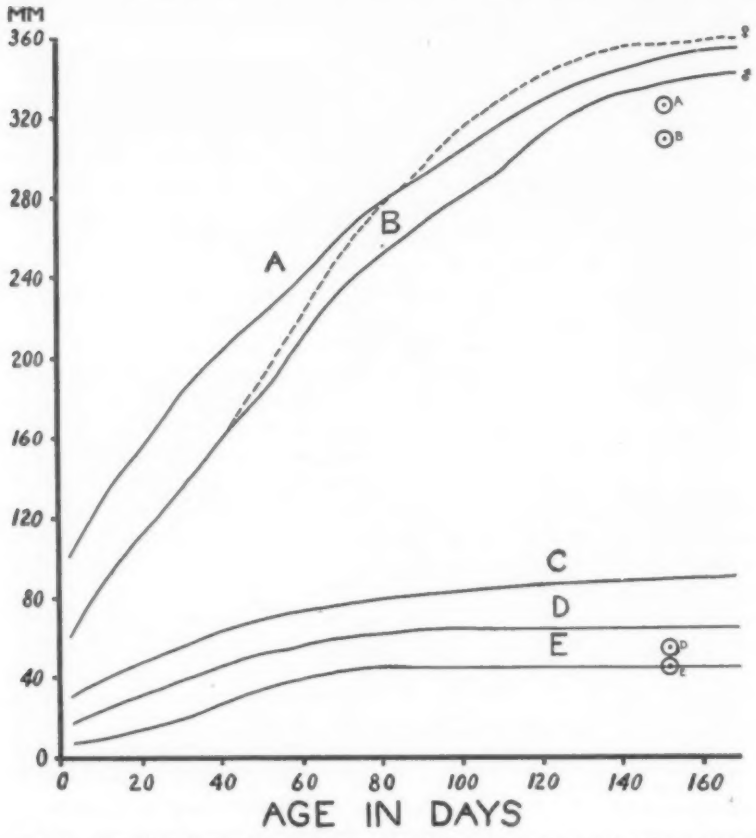

FIG. 2. Growth in *Bassariscus astutus:* A, head and body; B, tail (♂ and ♀ differentiated); C, head; D, hind foot; E, ear from notch. Measurements made by C. T. Vorhies recorded as circle dots.

measuring 4 mm. Areas of lighter colored fur occurred on the feet, on the circumocular region (except for the lids), and on the dorsal distal half of the ear; pure white fur was in the rings of the tail and in the ventral stripe connecting these rings. Areas of darker fur were at the base of, and on the proximal half of, the ear, the eyelids, and the muzzle between the eye and the base of the

vibrissae, and the black incomplete rings of the tail. Many of the dark brown vibrissae on each of the four young had broken off, leaving a base of 4 to 6 mm. The longest unbroken ones measured 24 mm in length. At this age the animals were completely furred with the exception of the dark pigmented rhinarium and the light unpigmented sole pads. The eyes, which had opened at

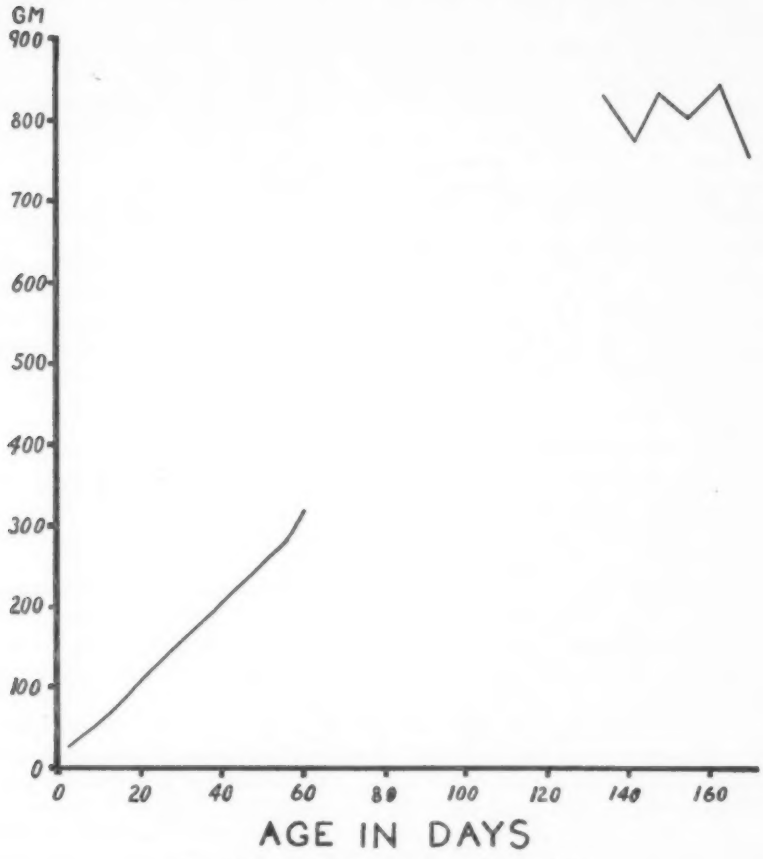

FIG. 3. Weights of growing *Bassariscus astutus*.

the age of 31 to 34 days, measured 11 mm between corners. The rather large external ears now drooped to either side of the head, concealing the auditory opening, and the young were able to twitch then. The auditory canal opened on the twenty-ninth day, but it was not until four days later that the young responded to a snapping noise made by my fingers. The muzzle had become longer and broadly pointed, but it was still unlike the sharp muzzle of the adult.

The tongue had lengthened and much of the lateral curl had disappeared. The only teeth through the gums were the upper and lower canines and third incisors, which protruded through the gums one-half millimeter. The relatively short tail had lost its fleshy appearance because of the covering hair and, likewise, the ventral curl, obvious on the new-born young, had straightened out. The feet were of more adult proportions, furred, and with sharp, recurved, nonretractile claws.

The metallic squeak, so characteristic of the younger animals, had decreased in frequency since the eyes had opened, but it now had more volume. The sweet musky odor still persisted about the young, although I had not observed the anal glands functioning as in the adult. The feces were of much the same character as those of the new-born young, for the animals were still suckling and not taking other nourishment. The fecal matter as well as the urine was being consumed by the female. The young maintained an equilibrium righting themselves quickly and maintaining themselves upright on a shifting inclined plane. When dropped belly up from a height of six inches, they were unable to alight on their feet. Locomotion was still imperfect; the usual method was to crawl with the belly on the ground, the front feet furnishing most of the motive power, the hind feet weakly pushing. As with the new-born, stroking the vibrissae produced little or no response. Touching the young with one's finger no longer stimulated them to move toward the stimulus.

LATER OBSERVATIONS ON THE FEMALE AND FOUR YOUNG

Development was rather rapid. Walking with the belly off the ground was first observed about the thirty-seventh day, four or five days after the eyes opened. This gait was awkward and could be sustained for only a short distance. The young became more difficult for the female to carry. They did not relax unless they were carried by the nape of the neck or grasped by the shoulder. When transported otherwise, they caught objects, thus impeding the female's progress. On one occasion, the female, struggling to unhook the claws of the young from a limb on which she was walking, lost her grasp, dropping her young four feet to the ground. The mother quickly returned the kitten, apparently none the worse for the fall, to the nest box. The breaking off of the vibrissae in this litter may have been abnormal; it was completed within a week after the eyes were open. The vibrissae of a single young of another female did not break off. The ears, which had drooped to either side, became stiff and adult-like in appearance within two and one-half months after birth. Solid food, such as cactus fruit and apples, became a part of the diet soon after the eyes opened, from about the thirty-sixth day on. It was at this time that the female discontinued the eating of excrement. At first the young voided wherever they were when the urge came upon them, but later they took to using the corner of the box opposite the nest. Time of weaning was not determined, as the family was broken up shortly after the second month and at that time it had not occurred. They were, however, leading a freer, more active life, eating a quantity of solid food and spending much of

the time apart from the female. Their weights and measurements increased rapidly. The metallic squeak was used less and less until it disappeared about one and one-half months after the eyes had opened. A new vocal sound, a spitting, explosive bark, occurred about two weeks after the opening of the eyes. It was first observed when a small dead bird was held in front of a young. This adult vocalization was a part of their response to strange objects. The agility of the young developed rapidly from the crawling gait to the quick, alert climbing, running, springing adult-like activities. A change in pelage occurred during this period, from the fuzzy juvenile coat to that of the adult. The change was first noticed toward the end of September when the young were approximately four months old.

SUB-ADULTS 134 DAYS OLD

At this age these animals resembled the adults except that they were slightly smaller in size. Their markings, as with the young of 35 days, were adult-like, differing chiefly in color tone and sharpness of definition. The dorsal color of the head and body was a grey brown tinted with buff and darkened by the black tipped guard hairs, which were more numerous along the middle of the back and less apparent on the sides. This produced a darker color than that of the adult. The ventral color was light buff with an orange tinge particularly noticeable on the throat and flanks. This buff color was more pronounced than in either the adult or the young of 35 days. As in the adult, the muzzle was predominantly grizzled grey in color, while the light colored eye patch was interrupted by the dark brown of the lids, which continued anteriorily to the base of the vibrissae. The hair on the bottom of the feet was stained a dirty brown. The brush, though considerably increased in size, still retained the seven incompleted black rings and a black tip, and the eight white rings joined ventrally with a white stripe. The erect pinna resembled that of the adult; internally the short fur permits the skin to show through, while at the outer base a patch of long white hair prevented large foreign objects from entering. Externally the pinna was completely covered with short hairs, those on the distal half almost white, while those on the proximal half were a dark brown. The hair lengths, on various parts of the body, were as follows: guard hairs on middle of back 30 mm, underfur middle of back 18 mm; guard hair at base of tail 33 mm, hair on dorsal central portion of tail 52 mm; guard hair on belly 27 mm, underfur on belly 13 mm. The dark brown vibrissae still showed the broken ends, although the longest of these had increased to a length of 39 mm. The rhinarium, as in the 35 day young and the adult, was pigmented; the sole pads were unpigmented. As compared with the young of 35 days, the eyes appeared larger, more open, and more bulged, measuring 15.5 mm across the ball from notch to notch. The muzzle had become sharper, more pointed, containing a long, thin tongue and a full set of adult teeth. The feet were adult-like in size and shape, possessing sharp non-rectractile claws. The sweetish musk odor, typical of the adult, was now clearly traced to the secretion of two or three drops of clear amber colored fluid from the anal glands.

The fluid appeared when the animal was frightened, spreading over the anal region. The species, as far as I have seen, makes no effort to throw or wipe the fluid on objects with which it comes in contact. The feces were adult-like. Of interest in this connection was the large quantity of material consumed during a night and the rapidity with which it was passed, resembling in this respect a distant relative the giant panda (Sheldon, 1937, p. 15). The voice had become exclusively the explosive bark of the adult. An excellent sense of equilibrium had been developed, as shown by their activities, running and jumping about the cage with the ease of a squirrel. When dropped from a height of six inches above the ground, they could alight on their feet. The vibrissae had become receptive, that is, the animals definitely moved away from the object that brushed against them. The testes, about 4 mm in diameter, had descended into the scrotum and were first observed there at the age of about 110 days. I have observed no case of sexual activity. However, Dr. Vorhies writes that one of the two young left with him (they were of the same litter) frequently attempted copulation with its mother. Some antagonism developed between the two caged animals during the last month. This occurred usually during feeding time when the male drove the female away from the food regardless of hunger. The male was the more nervous of the two, assuming the defensive more quickly than the female, snapping and barking at strange objects brought close to him.

SUMMARY

The new-born young of *Bassariscus* are small, pink, fuzzy, helpless creatures with closed eyes and ears, blunt muzzles, no teeth, small pinnae, and pigmented bands on their tails; they squeak and have awkward crawling, wriggling gaits.

The eyes open 31 to 34 days after birth, the ears some 5 days previously. The young are fully furred; the fuzzy juvenile pelt is lighter than that of the adult, but similarly marked. At this age the pinna droops; the muzzle is long; the canine and lateral incisor teeth are through the gums; the rhinarium is pigmented. The gait is an awkward crawl, and the squeak is less frequent.

By 134 day the young are sub-adult with adult appearance and activity. Their eyes are wide and bulging; they have a full complement of adult teeth, a muzzle long and narrow, erect ears, a long and full tail brush, and functional anal glands. The voice is an explosive bark. The male has scrotal testes about 4 mm in diameter.

LITERATURE CITED

GRINNELL, JOSEPH, JOSEPH S. DIXON, AND JEAN M. LINSDALE. 1937. Fur-bearing mammals of California: Their natural history, systematic status, and relation to man. Univ. Calif. Press, vol. 1 (in two volumes), pp. xii + 375, pls. 1–7, fig. 1–375.

SHELDON, W. B. 1937. Notes on the Giant Panda. Jour. Mamm., vol. 18, pp. 13–19.

Archbold Expeditions, American Museum of Natural History.

SIZE OF HOME RANGE AND NOTES ON THE LIFE HISTORY OF THE WOODLAND DEER-MOUSE AND EASTERN CHIPMUNK IN NORTHERN MICHIGAN

By W. Frank Blair

One hundred and fifty-one woodland deer-mice (*Peromyscus maniculatus gracilis*) and 154 eastern chipmunks (*Tamias striatus lysteri*) were trapped alive on an 18.18 acre plot in virgin hardwood forest in Alger County, Michigan, between August 25 and September 22, 1940. Several hundred recaptures of these animals indicate the size of their individual home ranges and provide information on certain aspects of the life history of the two species.

The field work was conducted on the Cusino State Game Area. I am greatly indebted to Adolph Stebler and Ford Kellum of the State Department of Conservation for many courtesies rendered during my stay in the area. J. S. Rogers, Jr., assisted in the field work. The statistical computations are by D. M. Clarke. The field expenses were in part defrayed by the Laboratory of Vertebrate Genetics, University of Michigan.

METHODS

The method of trapping already has been described in detail (Blair, in press). Small live traps were set 45 feet apart in a grid pattern over 18.18 acres in the midst of an extensive virgin hardwood forest. Near the end of the field work a line of traps with the traps 45 feet apart was set 90 feet distant from the plot and around it. The traps in this line were set for 5 nights, and were used to determine which residents of the plot had home ranges extending beyond the regular trapping area. The plot itself was trapped for 28 days between August 25 and September 22, 1940, but only one-half of the traps were set at any one time. Alternating series of three lines each were set during alternate weeks. If an animal was caught in the same trap on two consecutive nights that trap was left unset on the third, thus allowing that individual to be caught in some other part of its home range. Otherwise the traps were left set continuously during the 7 days of each trapping period. They were visited in the morning and evening, and all captive mammals were removed, marked, and released at the point of capture. The deer-mice were mostly trapped during the night, but a few were trapped during the day. The chipmunks were taken in the traps both in the morning and evening, but they were most numerous in the evening. The traps were baited with sunflower seed, except during the last week, when rolled oats and peanut butter were added to the seed. The mixture seemed no more attractive to the small mammals than did the sunflower seed alone. A standard method of calculating the size of the home range (Blair, 1940a) has been used. Differences between two means that are greater than 2.7 or more times the standard error of their difference are considered statistically significant.

In the field notes 5 age classes of deer-mice are recognized. Immature animals are those still in juvenile pelage. Subadults are changing from juvenile

to the first adult pelage. Young adults have attained the first adult coat, but have not reached full adult size. Adults are fully mature in size. Old adults are grizzled individuals that definitely are the oldest mice in the population. For the purpose of summarization, in the present report the immatures and subadults are combined as immature or non-breeding animals, while the three other classes are grouped as the mature or potentially breeding section of the population.

The age classes of the chipmunks were not so easily identified as those of the deer mice. Consequently, only two classes—immature and adult—have been recognized.

PEROMYSCUS MANICULATUS GRACILIS

Home ranges.—Although 151 deer-mice were trapped on the plot, reasonably accurate determinations of the home range could be made for only 70, or less than one-half of them. Many were caught too few times to indicate the extent of their home ranges and others had ranges that obviously extended beyond the limits of the trapping area. All individuals that were caught less than 10 times have been excluded from the calculations of home range size, because those that were caught many more times than that seldom ceased to increase the size of their known home ranges until the tenth or later capture. Among the 70 deer-mice that were caught 10 or more times, the size of the known home range of 10 individuals increased slightly with the last capture, which on the average was the fourteenth. In the other 60 that were caught 10 or more times, the number of captures necessary before the size of the known home range ceased to increase varied from an average of 10.4 times for immature males to 18.6 times for mature males (see Table 1). This method of determining the adequacy of the home range data is similar to that used by Haugen (unpublished thesis) for the cottontail. To exclude from the calculations of home range size most of those individuals whose ranges extended beyond the trapping area, no home ranges are included that were limited to the 4 outer lines of the regular plot and the line 90 feet distant. Twelve of the 70 animals included in the calculations of home range size had ranges that extended to the line 90 feet distant from the regular plot. These individuals, however, had ranges that lay partly within the 4 outer lines of traps. Even though it is possible that the ranges of some of these extended beyond the 90 foot distant line they have been included in the calculations because some of these ranges are among the largest recorded.

The average size of the home ranges in the various sex and age classes are shown in Table 1. The average adult male deer-mouse range of 2.31 ± .27 acres was significantly larger than the adult female range of 1.39 ± .16 acres, the difference in the means being 0.92 ± .31 acre. Likewise, the adult males had significantly larger ranges than either the immature males or the immature females, the difference in means being, respectively, 1.42 ± .29 and 1.23 ± .32 acres. The home ranges of the adult females were not significantly larger than those of the immature males or females. There was no significant difference

in size between the home ranges of the immature males and those of the immature females.

A comparison of the size of the woodland deer-mouse (*P. m. gracilis*) home range with that of the prairie deer-mouse (*P. m. bairdii*) of southern Michigan is difficult, for the data on *gracilis* are considerably more adequate than those obtained by the comparatively crude trapping technique used in the study of *bairdii* (see Blair, 1940b: 274). For the purpose of comparison, however, those home ranges of prairie deer-mice based on 10 or more captures each seem fairly adequate and have been averaged (see Table 1). The adult male *gracilis* with an average of 2.31 ± .27 acres had a significantly larger home range than the 0.77 ± .06 acre range of adult male *bairdii*, the difference in the means being 1.54 ± .28 acres. Likewise, the adult female *gracilis* with 1.39 ± .16 acres had a significantly larger range than the adult female *bairdii* with 0.63 ± .07 acres, the difference in the means being 0.76 ± .17 acre.

TABLE 1. *Average size of home ranges of woodland deer-mice (Peromyscus maniculatus gracilis) and prairie deer-mice (P. m. bairdii), with standard errors and extremes*

GRACILIS		NUMBER OF INDIVIDUALS	AVERAGE NUMBER OF TIMES CAUGHT	AVERAGE NUMBER OF CAPTURES BEYOND WHICH SIZE OF HOME RANGE CEASED TO INCREASE	SMALLEST HOME RANGE IN ACRES	LARGEST HOME RANGE IN ACRES	AVERAGE SIZE OF HOME RANGE IN ACRES
Age	Sex						
Ad	♀	14	22.3	17.5	0.75	3.28	1.39 ± .16
Ad	♂	27	22.2	18.6	0.88	5.64	2.31 ± .27
Im	♀	17	14.1	10.5	0.35	3.39	1.07 ± .17
Im	♂	12	13.5	10.4	0.45	1.60	0.89 ± .10
BAIRDII							
Ad	♀	13	11.1	unknown	0.43	1.41	0.63 ± .07
Ad	♂	14	11.3	unknown	0.29	1.17	0.77 ± .06

The data here presented comprise a greater number of trap records of individual mice than previously have been available in studies of the home ranges of any small mammals. In figure 1, a representative home range of an adult male woodland deer-mouse that was caught 23 times and of an adult female that was taken 29 times are shown. The solid line connecting the outer limits of the small squares is the conventional limit of the calculated home range. The squares are formed by the lines half-way between a trap in which the individual was caught and the adjacent traps. The number of times that the mouse was caught in each trap within its calculated range is shown by shading. With the home range thus diagrammatically indicated, several facts about its nature become evident. In each home range that was portrayed in this manner, the owner was caught more times in one particular trap than in any other. In the two examples plotted, the female was caught 6 times in one trap within her home range, and the male was taken 4 times in one trap within his range. It seems logical to assume that the trap in which a mouse is taken most frequently is nearer its home site than are the others. If this assumption is valid

it is immediately evident that the home site of a mouse does not necessarily lie near the center of its home range. In fact, of several ranges diagrammed, the assumed home site of the female shown in figure 1 was the nearest of all to the center of the home range. In the case of the male shown in the same diagram, the assumed home site was near the periphery of the calculated range. From these examples it seems certain that the home ranges of woodland deer-mice do not extend at random from their respective home sites. Because the mice do not range at random, it appears that some factors in the biotic community must condition the shape and extent of each individual home range. Precisely what these factors are has yet to be demonstrated. However, it seems probable that the local distribution of particular plants that serve as

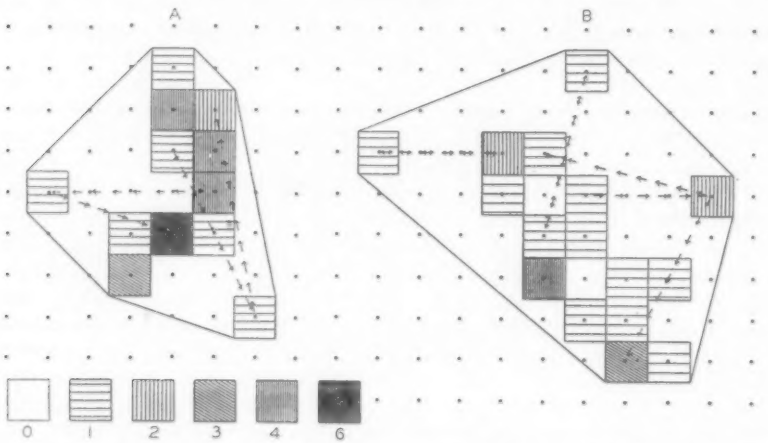

FIG. 1. Diagram of the calculated home range of breeding female (A) and breeding male (B) woodland deer-mouse, showing the number of times each was caught in the various traps within its home range. Dots indicate traps, spaced 45 feet apart. Each shaded square is formed by the lines half-way between a trap in which the mouse was caught and the adjacent traps. Where a shaded square is not contiguous with the others, arrows lead from the previous trap in which the mouse was taken and to the subsequent one.

food or cover might be of paramount importance in determining the location of the individual home ranges. Relationships with other animals of the same and of different species probably, too, is important.

In general, the amount of use of a given part of its home range by a mouse should vary in direct proportion to the number of times that it was caught there. The least visited parts of the home ranges were, as would be expected, usually around the periphery. As a rule, there were also numerous traps within the home range in which the mouse was not taken at all. These traps in which the mouse was not taken separated traps in which it was caught (see fig. 1). It is obvious that in going to the outer traps the mouse had to cross the areas in which it was not taken. With many more captures, the mouse

probably would be caught in some traps into which it had not gone at the end of my trapping. On the other hand, it is quite possible that some of the traps were in places so devoid of cover that they were consistently avoided. Unfortunately, in this respect, no detailed analysis of the vegetation was feasible in the present study.

The calculated home ranges of all sex and age classes broadly overlapped one another. Thus there was no occupation of exclusive home ranges by breeding females such as Burt (1940: 28) believes to be characteristic of the woodmouse (*Peromyscus leucopus noveboracensis*) and Strunk (unpublished thesis) and Blair (1940a: 154) believe characteristic of the meadow vole (*Microtus p. pennsylvanicus*). In one part of the plot the calculated ranges of 4 adult females broadly overlapped. Examination showed that each of these animals bore a litter of young during the time that the area was being trapped.

One might suspect, after an examination of the detailed diagrams of home ranges (fig. 1), that the apparent overlap of ranges was in reality interdigitation of contiguous ranges. It might be expected that the areas within the calculated home range of a given mouse in which that animal was not caught were in actuality part of the exclusive territory of an overlapping range. Such did not prove to be the case, however. In the case of the 4 breeding females with overlapping ranges mentioned above, two females were frequently caught, on separate occasions, in the same traps in the area of overlap. Meanwhile, several traps within the limits of the mutually occupied areas never were entered by any of the females. Thus it is clearly evident that the home ranges of breeding females do overlap broadly. The fact that both of two individuals in an area of overlap failed to be caught in certain traps gives added weight to the theory that some areas within a home range may be avoided as unfavorable. The absence of exclusive home ranges in breeding females also has been demonstrated for the prairie deer-mouse (*Peromyscus m. bairdii*) in southern Michigan (Blair, 1940b: 285).

Social relations.—That individual woodland deer-mice are highly tolerant of one another is indicated by the foregoing discussion of overlapping home ranges of all sex and age classes. Further evidence of this tolerance is found in the capture, on 10 occasions, of two individuals in the same single-catch type of trap. With these traps it is practically impossible that two individuals could be caught in the same trap unless they entered simultaneously. In three instances, two young adult males were in the same trap, and at one time a young adult and a subadult male were caught together. Two immature males were caught together in one trap. In three cases, a young adult male was in a trap with an immature or subadult female, and once a young adult male and a young adult female were trap mates. In one instance, a young adult female and a subadult male were caught together. The fact that males were taken together 5 times in the traps, while females never were caught together possibly indicates more tolerance among males than among females.

The most interesting pair found in one trap comprised a young adult male deer-mouse and an adult male woodland jumping mouse (*Napaeozapus insignis*

frutectanus). As the two mice must have entered the trap together and as there was no evidence of fighting it seems that a considerable amount of tolerance exists between at least the males of the two species.

Sex ratio.—Of the 151 deer-mice trapped on the plot, 83 (54.9%) were males and 68 (45.1%) were females. This would seem to indicate a fairly even sex ratio, with the males slightly in excess of the females. In actuality, the apparent moderate excess of males is in part at least attributable to the fact that the adult males have larger home ranges than any of the other sex and age classes of deer-mice. Since the adult males had larger ranges than the others, they were trapped from a larger area beyond the limits of the plot than were the others. When the size of the area from which each sex and age class was being trapped was calculated by adding one-half the width of their respective, average home ranges to each side of the plot, the average population per acre comprised 2.025 males and 1.947 females of all age classes. Thus the population per unit area was made up of 51.0% males and 49.0% females. This is a more nearly even sex ratio than would seem evident if the difference in

TABLE 2. *Percentage of mature deer-mice breeding during the 4 trapping periods, August 25 to September 22, 1940*

DATE	MALES			FEMALES		
	Number examined	% Breeding	% Non-breeding	Number examined	% Breeding	% Non-breeding
Aug. 25–31	40	75.0	25.0	21	85.7	14.3
Sept. 1–7	40	70.0	30.0	15	86.7	13.3
Sept. 8–14	42	76.2	23.8	20	55.0	45.0
Sept. 16–22	49	71.4	28.6	27	33.3	66.7

the size of the areas from which the various classes of mice were trapped had not been taken into account.

Breeding.—Every deer-mouse was examined at least once during each trapping period to determine its breeding condition. Sexual activity in the males is indicated by their enlarged testes, located in the scrotum. In non-breeding males the testes are small and abdominal. The females were classed as apparently pregnant, suckling, or non-breeding. The breeding data for the males probably are more reliable than those for the females, because the early stages of pregnancy usually are impossible to detect. Accordingly some females that were recorded as non-breeding possibly were pregnant. Furthermore, frequent long stays of suckling females in the traps and the consequent neglect of the young possibly resulted sometimes in the death of the young.

The records of breeding activity are summarized in Table 2. In the males, there was little fluctuation in the ratio of breeding to non-breeding animals, with about three out of every 4 individuals examined being sexually active. In the females, the ratio of breeding to non-breeding animals changed greatly from the first to the last week of trapping. In the first two weeks of trapping approximately 6 of every 7 mature females examined were either suckling or apparently pregnant, but in the last week only one of every three was breeding.

The available data indicate that the breeding season of the woodland deer-mouse extends through late summer and early fall, but they do not clearly show the end of the breeding season. However, the decrease in breeding females in the last trapping period, September 16 to 22, suggests an approach to the end. It is impossible to determine definitely from the present evidence whether or not there is a lull in sexual activity in midsummer such as was found in the prairie deer-mouse (Blair, 1940: 298). In this connection, however, it is significant that 10 (47.6%) of the 21 adult and young adult females examined during the first week of trapping showed by the condition of their mammae that they recently had suckled young. Thus they are known to have been breeding during late July and early August, and immature mice that must have been born during that time were found on the plot when the trapping was begun. If there was any lull in breeding, therefore, it must have been rather early in the summer.

Parasites.—Bot-fly larvae were found beneath the skin of one female and one male of the 159 deer-mice examined on the plot and in the line 90 feet away. In both cases the larva was in the inguinal region. The larvae were observed during the week from September 8 to 14, 1940. A much smaller fraction of the population of deer-mice was infested with bot-fly larvae than of woodland jumping mice (*Napaeozapus insignis fructectanus*) (Blair, 1941) and of chipmunks. It is interesting that even a few of the woodland deer-mice were infested, for in southern Michigan a grassland inhabiting subspecies of the deer-mouse (*Peromyscus m. bairdii*) never was found to be infested, while wood-mice (*Peromyscus leucopus noveboracensis*) in the same region were heavily infested. It appears that there possibly is a correlation between the forest environment and infestation.

TAMIAS STRIATUS LYSTERI

Home ranges.—The same methods have been used in calculating the size of the the chipmunk home ranges that were used for the woodland deer-mouse. Similar criteria also have been used to determine which home ranges are sufficiently complete to be included in the statistical computations of home range size. Only chipmunks that were caught 10 or more times are included in the calculations. Of the 68 chipmunks that were caught 10 or more times the size of the calculated home range of 13 increased slightly with the last capture, which on the average was the sixteenth. In the other 55 chipmunks that were caught 10 or more times, the number of captures necessary before the size of the known home range ceased to increase varied from an average of 15.6 for adult females to 21.1 for immature females. Seventeen of the 68 chipmunks included in the calculations had ranges that extended to the line 90 feet distant from the regular plot. Even though it is possible that the ranges of some of these extended beyond the 90 foot distant line they have been included because some of these ranges are among the largest on the plot.

The average size of the home ranges for the various sex and age classes of chipmunks are shown in Table 3. The average home range of adult females comprised 2.15 ± .38 acres; of adult males, 2.31 ± .30 acres; of immature

females, 1.78 ± .18 acres; and of immature males, 2.68 ± .48 acres. There is no significant difference in size of home range between any of the sex and age classes. The size of the chipmunk home range in northern Michigan is approximately the same as Burt (1940: 44) found for the same species in southern Michigan.

The home ranges of the adult males, immature males and females, and non-suckling adult females broadly overlapped. Of the 8 adult females that definitely suckled young at some time while the area was being trapped, the ranges of only two broadly overlapped one another. This possibly indicates that breeding females occupy home ranges from which other breeding females are excluded. However, the number of breeding individuals was so small that the apparent paucity of overlap of ranges might have been due to chance. If there is any exclusion of other breeding females from a home range this certainly does not apply to non-breeding adults, for the ranges of non-breeding adult females broadly overlapped the ranges of the suckling animals.

Several chipmunk home ranges were plotted as were the deer-mouse ranges shown in figure 1. As in the case of the deer-mouse, the trap in which a given

TABLE 3. *Average size of home ranges of eastern chipmunks (Tamias striatus lysteri) with standard errors and extremes*

AGE	SEX	NUMBER OF INDIVIDUALS	AVERAGE NUMBER OF TIMES CAUGHT	AVERAGE NUMBER OF CAPTURES BEYOND WHICH SIZE OF HOME RANGE CEASED TO INCREASE	SMALLEST HOME RANGE IN ACRES	LARGEST HOME RANGE IN ACRES	AVERAGE SIZE OF HOME RANGE IN ACRES
Ad	♀	16	24.0	20.6	0.58	7.27	2.15 ± .38
Ad	♂	16	19.7	15.6	0.91	4.71	2.31 ± .30
Im	♀	20	23.6	21.1	0.84	3.56	1.78 ± .18
Im	♂	16	21.4	19.3	0.79	8.01	2.68 ± .48

chipmunk was taken most frequently sometimes was near the center of the home range and sometimes near the edge. This indicates that the home range of a chipmunk, too, does not necessarily extend at random from its home site. The least visited parts of the chipmunk home ranges usually were near the periphery. As in the wood-mouse, some areas within the chipmunks' home ranges apparently were avoided as unfavorable.

Social relations.—The chipmunks were definitely less tolerant of one another than were the deer-mice. On numerous occasions one chipmunk was seen chasing another to the accompaniment of vigorous chattering. Burt (1940: 44) noted that of a male and female chipmunk that came to the same feeding station the first animal there drove the other away. This antagonism seems to be widespread among the Sciuridae, for Gordon (1936: 171) observed pine squirrels (*Tamiasciurus fremonti* and *T. douglasii*), mantled ground squirrels (*Citellus lateralis*), and western chipmunks (*Eutamias quadrivittatus*) chasing others of their respective species.

The antagonism between individual chipmunks did not prevent the broad overlapping of the home ranges of all sex and age classes.

Sex ratio.—Of the 154 chipmunks trapped on the plot, 79 (51.3%) were males and 75 (48.7%) were females. On the basis of the average population of each sex per acre, there were 1.833 (53.2%) females per acre and 1.614 (46.8%) males. Thus, with either method of calculating the sex ratio, a fairly even number of males and females is indicated. The first method used above is equally as reliable in the case of the chipmunk as is the calculation based on the average number of each sex per acre, for there is no significant difference in the size of the male and female home ranges.

Breeding.—Only one (5.6%) of the 18 adult male chipmunks examined from August 25 to 31 had enlarged testes indicative of sexual activity. None of the 32 adult males examined September 1 to 7 and none of the 25 observed September 8 to 14 was in breeding condition, the testes being small. One (3.6%) of 28 adult males handled between September 16 and 22, however, had large testes. From the examination of the males, it appeared evident that the breeding season was near its close.

Of the 15 females examined during the first week, August 25 to 31, none appeared to be pregnant or to be suckling young. However, 10 (66.7%) of them showed by the condition of their mammae that they more or less recently had weaned young. Four (14.8%) of the 27 females recorded during the second week and 5 (23.8%) of the 21 examined during the third week were suckling young. Four (16.0%) of the 25 observed during the fourth week were suckling. Thus the examination of the females, as well as of the males, indicated an approach to the end of the breeding season.

Parasites.—Of 165 chipmunks examined, 62 (37.6%) were infested with bot-fly larvae at some time during the trapping. The larvae usually were in the inguinal region, and some individuals had there as many as 4 or 5 of these parasites. In some instances, the larvae were in the back or side. The number of individuals infested was proportionately greater than in the woodland jumping mouse (*Napaeozapus insignis fructectanus*) in the same area (Blair, 1941), and it was much greater than in the woodland deer-mouse. The wounds left when the larvae dropped from their hosts usually oozed pus, but they healed after several days.

SUMMARY

One hundred and fifty-one woodland deer-mice and 154 eastern chipmunks were trapped alive, marked, released, and retrapped on an 18.18 acre plot in the midst of an extensive virgin hardwood forest in Alger County, Michigan. During the field period, from August 25 to September 22, 1940, the size of the home ranges of adult male deer-mice averaged 2.31 ± .27 acres; of adult females, 1.39 ± .16 acres; of immature females, 1.07 ± .17 acres; and of immature males, 0.89 ± .10 acre. The home ranges of the adult male deer-mice were significantly larger than those of any of the other sex or age classes. The home ranges of the adult male and adult female woodland deer-mice both averaged significantly larger in size than those of the prairie deer-mouse in southern Michigan.

The size of the home ranges of adult male chipmunks averaged 2.31 ± .30 acres; of adult females, 2.15 ± .38 acres; of immature females, 1.78 ± .18 acres; and of immature males, 2.68 ± .48 acres. There was no significant difference in size of home range between any of the sex or age classes. In both the deer-mouse and chipmunk, the home ranges of all sex and age classes broadly overlap one another. Individual deer-mice are highly tolerant of one another, but chipmunks frequently are antagonistic toward other individuals of the same species.

LITERATURE CITED

BLAIR, W. FRANK. 1940a. Home ranges and populations of the meadow vole in southern Michigan. Jour. Wildlife Management, vol. 4, pp. 149–161, 1 fig.

———— 1940b. A study of prairie deer-mouse populations in southern Michigan. Amer. Midland Nat., vol. 24, pp. 273–305, 4 figs.

———— 1941. Some data on the home ranges and general life history of the short-tailed shrew, red-backed vole, and woodland jumping mouse in northern Michigan. Amer. Midland Nat., vol. 25, no. 3, pp. 681–685.

BURT, WILLIAM HENRY. 1940. Territorial behavior and populations of some small mammals in southern Michigan. Misc. Publ. Univ. Mich. Mus. Zool., no. 45, pp. 1–58, 2 pls., 8 figs., 2 maps.

GORDON, KENNETH. 1936. Territorial behavior and social dominance among Sciuridae. Jour. Mamm., vol. 17, pp. 171–172.

HAUGEN, A. O. Life history and management studies of the cottontail in southern Michigan. Unpublished doctoral dissertation. University of Michigan.

STRUNK, WILLIAM. Territory in *Microtus pennsylvanicus*. Unpublished doctoral dissertation. University of Michigan.

Laboratory of Vertebrate Genetics, University of Michigan, Ann Arbor, Michigan.

SHREWS AS A CHECK ON DOUGLAS FIR REGENERATION

By A. W. Moore

Moles and shrews are classed as insectivores in the classification of mammals and this insect feeding habit is generally recognized. Pacific northwest moles, however, have been found to vary their diet with seed and other vegetative material (Moore, 1933).

Collectors of small mammals have repeatedly called attention to the trapping of shrews with the use of oatmeal as bait, an indication that these animals, classified as insect eaters, have a more diversified appetite. Hamilton (1930) reports keeping the short-tailed shrew (*Blarina brevicauda talpoides*) in captivity where sunflower seed and soft corn were eaten. Merriam (1886) reported a captive *Blarina* ate beechnuts. Unfortunately shrews are difficult to keep in captivity. Nearly all of those taken in live traps are dead when found, and when post-mortemed little or nothing is found in the stomach despite the ample supply of Douglas fir seeds placed within the trap. An extremely nervous disposition may be a factor contributing to death, although a Trowbridge shrew (*Sorex trowbridgi*) that had lost practically its entire tail in a snap trap was taken the succeeding night in another trap.

The first indications that shrews are fond of Douglas fir seeds were observed near Ryderwood, Wash., in 1936 (Moore, 1940) when traps baited with this material yielded an occasional wandering shrew (*Sorex vagrans*). Later, on the same area, Douglas fir seed spots placed in duffy soil and covered with screen cones were raided, apparently by small burrowing animals.

During trapping operations from November 6, 1937, to April 9, 1938, in the fog-belt area along the Oregon coast in the vicinity of Otis, a logged-over area two hundred feet square that had been slash-burned several weeks before yielded, with the use of Douglas fir seeds as bait, the following animals: 34 white-footed mice (*Peromyscus m. rubidus*), 5 Trowbridge shrews (*Sorex trowbridgii*), 1 Baird shrew (*Sorex bairdi*), and 1 Gibb's shrewmole (*Neurotrichus gibbsii*). Live traps were used, and the mice were ear marked and released. That the burning of the slash destroyed the shrews that had been living on the area is indicated by the fact that the first shrew was taken on January 11 (Plate I, lower left).

During the same period, on a similar sized area in an unburned tract in the same vicinity, and with the same bait material, the following animals were taken: 12 white-footed mice (*Peromyscus*), 1 red-backed mouse (*Clethrionomys c. californicus*), 5 chipmunks (*Eutamias t. townsendii*), 50 Trowbridge shrews, 16 Baird shrews, 5 Yaquina shrews (*Sorex pacificus yaquinae*), and 5 Gibb's shrewmoles.

It having been noted that none of the adult seed-eating rodents common to the Oregon coast region could pass through a ½ inch mesh screen, but that three of the common shrews passed through it at will, a study of the relationship of shrews to spot-planted Douglas fir seeds was started in January 1939 on the Cascade Head Experimental Forest with the assistance of personnel of the field

station. The study area selected was approximately half an acre that had been inadvertently cleared during road construction about two years previously and was surrounded by a 90-year-old stand of Sitka spruce and hemlock. Ground cover consisted primarily of mosses, oxalis, miner's lettuce, salmonberry, and elder (Plate 1, upper left).

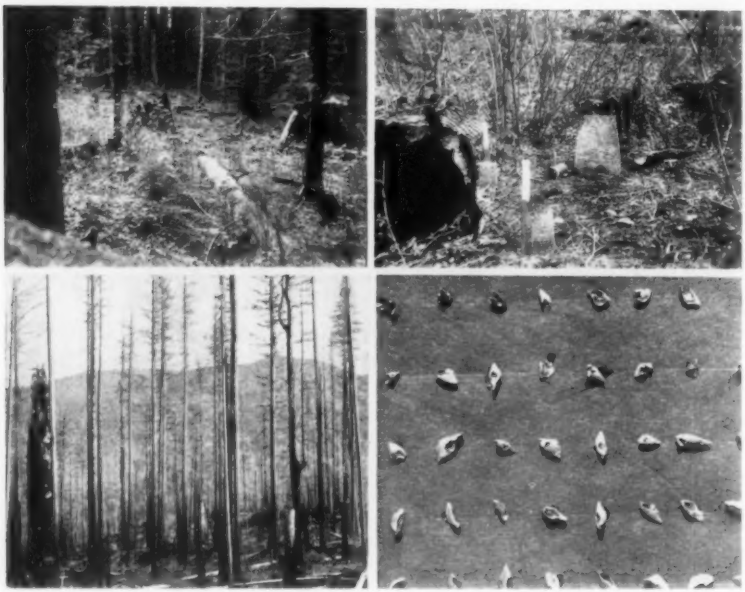

PLATE 1

Upper left.—Small clearing in a ninety-year-old forest consisting mainly of Sitka spruce and hemlock, in which the studies were conducted.

Lower left.—Selectively logged area upon which the burning of the remaining debris, or "slash," apparently removed the shrews. Young trees left standing also killed by fire.

Upper right.—Equipment used in field work in shrew study. Trap placed within ¼ inch mesh cages took only shrews. Traps placed outside of cage captured chipmunks and white-footed mice while ½ inch mesh in end of traps enabled shrews to escape.

Lower right.—A marked difference may be noted between the manner in which the white-footed mouse and shrew hull Douglas fir seed. Two top rows hulled by a shrew and middle row tested by same animal. Two bottom rows hulled by white-footed mice.

A similar habitat about half a mile distant was inventoried a month earlier to determine the seed-eating fauna common to the area, Douglas fir seeds being used as trap bait. Seven nights of trapping between December 14 and 30 yielded 5 red-backed mice, 11 white-footed mice, 2 Townsend chipmunks, 9 Trowbridge shrews, 6 Baird shrews, 1 Yaquina shrew, and 1 flying squirrel (*Glaucomys sabrinus oregonensis*).

In conducting the study, six rows of twelve spots each containing approxi-

mately 25 Douglas fir seeds were placed in the clearing. Spots were about 5 inches in diameter, and the seeds were lightly raked in. Row 1 was a control. Row 2 was screened with ⅓ inch mesh cylinders about 15 inches long and 5 inches in diameter. The cylinders were sunk into the ground 3 inches, and the tops were closed. Row 3 was similarly screened with ½ inch mesh. Rows 4, 5, and 6 duplicated in order the first three rows.

Examination on June 13 showed clearly that the stand within the ⅓ inch mesh was satisfactory. With the exception of one spot, no germination was evident in the other rows. Final examination made on March 27, 1940, showed the following stand (Table 1):

TABLE 1

ROW	SPOTS
1, Control	[1]0 0 0 0 0 0 0 0 0 0 0 0
2, ⅓ inch screen	X 2 3 X X X 4 X X 0 X X
3, ½ inch screen	0 0 0 0 0 0 0 0 0 0 0 0
4, Control	0 0 0 0 0 0 0 0 0 0 0 0
5, ⅓ inch screen	X X X 0 2 0 5 X X X 0 1
6, ½ inch screen	0 0 0 0 0 0 0 0 0 0 1 0

[1] Legend: X = 12 or more seedlings; digits = actual number of seedlings; 0 = no seedlings.

During the period March 25 to April 9, 1940, further studies concerning the consumption of seeds by shrews were conducted with the use of ½ inch mesh cages placed upon the area. Edges of the screen were buried 4 inches in firmly packed clay soil. Within the cages were placed single live traps baited with Douglas fir seeds. Outside the cages were set live traps similarly baited but with the end of the nest can covered with ½ mesh screen to allow trapped shrews to escape. The ground surrounding the traps was baited rather heavily with Douglas fir seeds in an effort to attract the seed-eaters. Plate 1 (upper right) shows one of the four set-ups.

During this period four shrews, 3 Trowbridge and 1 Yaquina, were taken within the ½ inch mesh cages, while in the traps outside the cages 7 *Peromyscus* and 2 chipmunks were taken. The possibility exists that had the study been conducted over a longer period the percentage of shrews taken might have been higher. With the area baited with seed, and thus attracting the mice (caged *Peromyscus* readily consume dead shrews), the shrews may have been reluctant to forage over the area so long as the mice were present.

During the same period, at a short distance from the baited area, 105 trap nights yielded 25 white-footed mice, 12 Trowbridge shrews, 4 Yaquina shrews, 2 Baird shrews, 2 Oregon meadow mice (*Microtus o. oregoni*), and 1 Townsend chipmunk. The meadow mice were found in the dense forest, far removed from any meadow type or opening. Here again field observations indicated that the white-footed mice dominated the area.

Normally the hull remnants of Douglas fir seeds that have been fed upon by mice differ from those chewed by shrews (Plate 1, lower right). Mice re-

move as little of the hull as possible and normally leave clean-cut edges, whereas the shrews leave the edges rather serrated.

Another interesting observation made is that apparently the shrew samples each separate seed to determine whether the kernel is present. Studies of captive mice show that they seemingly can determine whether the kernel is present by merely picking up the seed. Cull seeds are usually rejected so rapidly that the motion is difficult to detect. Both the hulls and the kernels of Douglas fir seeds contain odors attractive to white-footed mice, as was shown in studies conducted near Ryderwood, Washington, in the winter of 1939–40, during which clay balls half an inch in diameter, some containing hulls, some kernels, and some neither hulls nor kernels were placed on a study plot. Those with the hulls were dug into as readily as were those with the kernels, but the "dummies" were not touched.

The stomachs of 17 shrews taken during the 1940 study were forwarded for examination of the Fish and Wildlife Service, Section of Food Habits, which reported that: "Plant materials made up 61.25% of the total. The major portion of the plant material was unidentifiable, this amounting to 33.4%. Douglas fir seed fragments were encountered in 13 of the stomachs wherein they ranged from 10 to 70% of the total contents, and made up 24.4% of all the food content. Oats (*Avena sp*) occurred in one stomach, making up 2.5% therein.

"Animal substances totaled 38.75% and of these the spiders were the largest item, amounting to 10%, and were found in 8 stomachs. Centipedes were listed in 3 cases and amounted to 7.5%. Moth and butterfly eggs and larvae, amounting to 7%, were encountered in 4 stomachs." The other animal species listed were: Two species of ground beetles (*Pterostichus* sp, 4.1%; *Calathus ruficollis*, 2.5%); beetle larvae in two instances, 1.2%; common angleworm 0.6%; flies, 5.6%, and occurring in 6 stomachs; weevils, 1.2%. Also, traces of beetles, parasitic wasps, and ground beetles were listed in 3 stomachs.

Possibly fir seeds are taken because of their high protein content and as a good substitute for animal food. Man has found beans a good substitute, and certain Indian tribes used piñon nuts for this purpose.

Further investigation to determine the relationship of shrews to forestation needs to be carried on. Sitka spruce, hemlock, and western red cedar are common to the coastal strip that contains the high shrew population. These are "small-seeded" trees. Hemlock seeds are the smallest, and that tree appears to be the most prolific in restocking. L. A. Isaac (1933, 1939), Associate Silviculturist, of the Pacific Northwest Forest and Range Experiment Station, advances the theory that these small-seeded species are dominant in places because the small seeds escape detection by seed-eaters, the factors of shade, seed trees, and growing site being given due consideration.

SUMMARY

Oregon coastal shrews vary their insect diet and contents of stomachs examined show at times a preponderance of vegetable matter.

Seed of the Douglas fir appears to be readily consumed by these insectivores. These seeds are the largest of the evergreen conifer seeds common to the Oregon coastal strip. The high shrew population may be a partial cause of the relatively sparse stand of Douglas fir and the dominants consisting of smaller seeded conifers; spruce, lodgepole pine, hemlock and alder.

LITERATURE CITED

HAMILTON, W. J. JR. 1930. The Food of the Soricidae. Jour. Mamm., vol. 11, no. 1, pp. 26–39.

ISAAC, L. A. 1933. Reforestation by broadcast seeding in the spruce-hemlock type. Forest Research Notes no. 11. Mimeographed. Pac. NW Forest Expt. Sta.

——— 1939. Reforestation by broadcast seeding with small-seeded species. Forest Research Notes no. 27. Mimeographed. Pac. NW Forest Expt. Sta.

MERRIAM, C. H. 1886. Mammals of the Adirondacks. N. Y. Henry Holt & Co.

MOORE, A. W. 1933. Food habits of Townsend and coast moles. Jour. Mamm., vol. 14, no. 1, pp. 36–40.

——— 1940. Wild animal damage to seed and seedlings on cut-over Douglas fir lands of Oregon and Washington. U. S. Dept. Agric., Tech. Bul. 706, 28 pp.

Fish and Wildlife Service, Hillsboro, Oregon.

NOTES ON THE DALL PORPOISE (*PHOCOENOIDES DALLI*)

BY SETH B. BENSON AND THOMAS C. GROODY

The recent capture of a Dall porpoise in San Francisco Bay furnishes an opportunity to record some data concerning this little-known species that has been taken in California but once previously. Porpoises of the genus *Phocoenoides* have seldom been collected and recorded. We know of the existence of only thirteen specimens, seven of which are skulls only, five are skeletons, and one is a fetus, as follows:

In his original description of *P. dalli*, True (1885) referred to two skulls. All the data in his paper concerning the skeletal and external characters were based on notes and drawings made by William H. Dall, who collected the two specimens off the coast of Alaska in 1873. The type specimen is a skull (see Lyon and Osgood, 1909, p. 5) collected on August 13, 1873, in the strait west of Adakh [=Adak] Island, Aleutian group, Alaska. The other specimen referred to by True was originally preserved as a complete skeleton, but all except the skull was destroyed by rats.

True (1889, p. 123) recorded a "second" skull received from Lieutenant Commander H. E. Nichols who obtained it from Hoonyah [=Hooniah] Sound, Alaska. At the same time True recorded another skull in the Berlin Anatomical Museum obtained from an unknown locality by Chamisso.

Andrews (1911) based his description of *P. truei* on a single specimen, preserved as a complete skeleton, collected on June 18, 1910, at Aikawahama, Rikuzen Province, Japan.

Mr. E. Z. Rett and Mr. M. E. Rodehaver collected a Dall porpoise on June

12, 1925, in the Santa Barbara Channel between Santa Cruz Island and Santa Barbara, California. This capture was recorded anonymously (Bull. Santa Barbara Mus. Nat. Hist., August, 1925, p. 6; October, 1925, p. 4). Mr. Rett informed us that the porpoise was one of a group of about ten individuals. This specimen is now no. 574, Santa Barbara Mus. Nat. Hist., preserved as a complete skeleton. Mr. Rett has generously supplied us with photographs of the porpoise and of its skeleton, together with other data.

Miller (1929) recorded a specimen of *P. dalli* from Wrangell, Alaska, collected on September 7, 1922, and two others (one a fetus) from Sullivan Island, Lynn Canal, Alaska, collected in November, 1926. There is no indication in his account that the two adult specimens consisted of more than the skulls.

Miller (1930) reported another complete skeleton of *P. dalli* from near Wrangell.

In a letter dated January 24, 1941, Remington Kellogg wrote that there is an additional skeleton from near Wrangell in the United States National Museum.

There is in the Museum of Vertebrate Zoology a previously unrecorded skull (no. 4755) collected at Mole Harbor, Admiralty Island, Alaska, on June 2, 1907, by Cyrus Catt (original number 38 of Annie M. Alexander). Field notes by Frank Stephens concerning it are as follows: "June 2. A porpoise brought by fishermen appears to be a *Phocæna*, but not *communis*. I think it was a female, but did not dissect. Its length was 1740 m.m.; pectoral fin 215; dorsal fin, 170; breadth of caudal 415. I photographed it. Littlejohn saved the skull." Also Stephens wrote, in a summary concerning the mammals collected in this locality, "Bay Porpoise. *Phocæna communis*. Porpoises came in the bay frequently, sometimes rising near the beach in front of camp. Two hunters shot a porpoise near the reef at the mouth of the bay that appeared to be a *Phocæna*, but was not a *communis*. It had a large patch of creamy white on the sides and abdomen from the middle of the body to near the tail." Unfortunately, the photograph referred to by Stephens is not in the files of the Museum of Vertebrate Zoology.

Other records of *Phocoenoides* are either indefinite as to whether specimens were preserved or are sight records only. Nichols (1926, p. 207) reported seeing the species in British Columbia waters at the north end of Vancouver Island on the east side of the Gulf of Alaska, and also in the open sea between the Aleutian Islands and Seattle, Washington, at 56° 36′ N. 145° 37′ W. and 52° 19′ N. 137° 42′ W. The last two records need confirmation because they appear to be the first to note the presence of this porpoise so far from shore and were based on distant views of porpoises breaking water.

The specimen reported on here, no. 94751 Mus. Vert. Zool., consists of a partly articulated skeleton and a strip of skin, including the dorsal fin and running to the midline of the belly, preserved in alcohol.

The porpoise was collected on October 12, 1940, at San Quentin Point, San Francisco Bay, Marin County, California, by members of the Grinnell Naturalists Society. According to the field notes of T. C. Groody the porpoise was

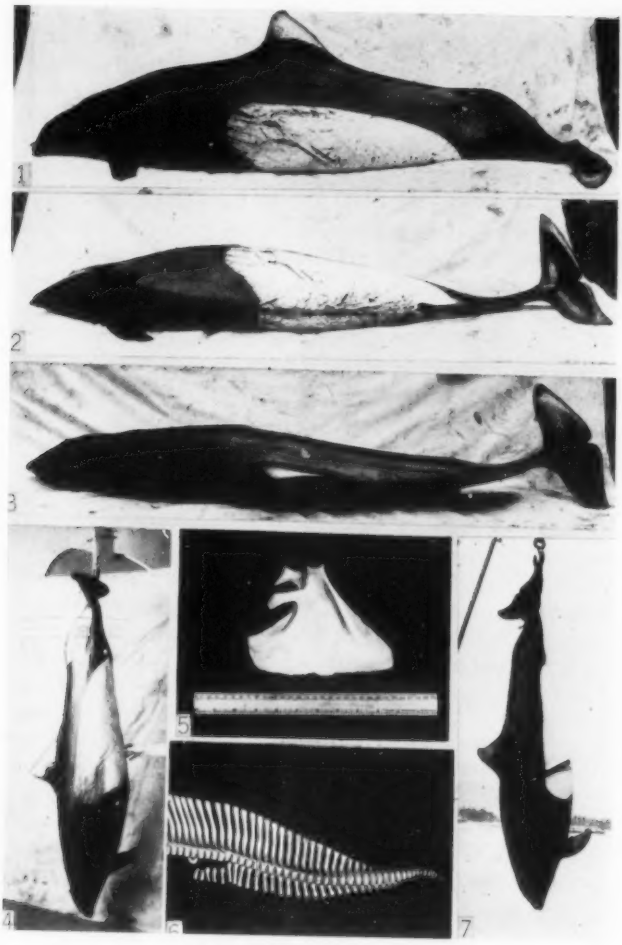

PLATE I

Photographs of two specimens of *Phocoenoides dalli* from California. Figs. 1–6 are of no. 94751 Mus. Vert. Zool., from San Quentin Point, San Francisco Bay, Marin County, California, collected October 12, 1940; fig. 7 is of no. 574 Santa Barbara Mus. Nat. Hist., from the Santa Barbara Channel, between Santa Barbara and Santa Cruz Island, California, photographed on June 12, 1925, by M. E. Rodehaver. Figs. 1–3. Lateral, ventral, and dorsal views in horizontal position. Fig. 4. Lateral view in suspended position to show shape of caudal peduncle. Fig. 5. Lateral view of left scapula. Fig. 6. Lateral view of caudal vertebrae, showing chevron bones in place. Chevrons 3 (represented by two pieces), 4, 5, 6, 30, 31, and 35 have been detached from the skeleton. Fig. 7. Dorso-lateral view in suspended position showing color pattern.

seen at about 1:30 p.m. circling in a confused manner in shallow water about fifty yards from shore. It was obvious that the animal was nearly stranded and was attempting to find deeper water. Some small boys said that the porpoise had appeared about half an hour earlier, presumably following a fish that had been caught and reeled in. They had attempted to help the porpoise into deeper water but had been unable to do so.

Instead of reaching deep water the porpoise came to within a few feet of shore where the water was about a foot deep. Groody lassoed it over the flukes and hauled it on shore where the animal thrashed about for 10 or 15 minutes before it died. During this time its breathing was labored and just before it died the respirations were almost explosive in nature and occurred at intervals of fifteen seconds. Over-exertion, exposure to the hot sunshine, and suffocation from difficulty in breathing on land probably caused its death. There were no signs of injury or disease other than slight superficial wounds and a moderately heavy infestation of nematodes in the lungs. According to Ellsworth C. Dougherty of the Department of Zoology of the University of California, the nematodes belong to an undescribed species of the genus *Halocercus*. The alimentary tract was empty except for a considerable amount of bile in the intestine. No intestinal parasites were found although careful search was made for protozoans.

The porpoise was an adult male. It weighed 252 pounds (approximately 114.3 kilograms). Measurements in centimeters are: Nose to notch between caudal flukes, 200; circumference of body behind flippers, 99; breadth across flukes (tip to tip), 57; height of dorsal fin, 18; slit of eye, 2.2.

COLOR

In pattern of coloration our specimen is intermediate between the type specimens of *dalli* and *truei* in so many respects that we conclude that the pattern in *Phocoenoides* is highly variable and that the differences in color between the type specimens are not of specific order. In our specimen the white area on each side extends forward a short distance past the line of the anterior border of the dorsal fin. In this character it is closer to *dalli* than to *truei*. This is also true of the specimen from Santa Barbara as is shown in a photograph (figure 7).

The dorsal fin in our specimen is more distinctly marked with white than that in *truei* or *dalli*, or in the specimen from Santa Barbara. This whitish area is streaked with black in lines that resemble streaks of paint splashed on from the front. Streaks are also present on the anterior and posterior borders of the lateral and ventral white areas. Both True and Andrews describe similar streaks. There is a broad whitish band on the posterior margin of the flukes in our specimen. This is not completely shown in the photographs because most of the skin on the edge of the flukes was scraped off while the porpoise was struggling to escape, and the wound appears as a dark band. The presence of white on the flukes was given by Andrews as one of the important differential characters in proposing *truei* as a species distinct from *dalli*. In a letter dated

January 27, 1941, Mr. Rett stated that there was no white on the flukes of the Santa Barbara specimen. Our specimen is also intermediate between the two type specimens in that the anterior extension of black on the ventral surface includes the anus, as in *truei*, but is narrower and not trident shaped. According to the drawing given by True, this extension of black does not include the anus in *dalli*. However, such details are not clearly shown in the crude drawings accompanying True's description. Our specimen lacks the grayish area on the ventral surface and lower sides of the caudal peduncle that is described and figured by Andrews for *truei*. The color of the inside of the mouth is a muddy pink in our specimen.

FORM

In body form our specimen is similar to *truei* as represented in the photographs accompanying the description by Andrews. Such differences in contour as are apparent result chiefly from differences in the positions of the specimens when they were photographed. The type specimen of *truei* was lying on a bench, whereas ours was on canvas on a lawn, or was suspended. The similarity in the shape of the ventral part of the caudal peduncle is not well shown in the lateral view in the horizontal position (figure 1), but is well shown in the photograph of the porpoise in the suspended position (figure 4). This photograph shows also that the shape of the caudal peduncle is similar in general to that shown in the drawing of the type of *dalli*.

We believe that *dalli* and *truei* are alike in body form although Andrews wrote (p. 34) "The shape of the body of *P. truei* posterior to the dorsal fin is totally unlike that of *P. dalli*," and stressed the fact that *truei* was distinct from all other cetaceans in this character. Andrews probably based this statement on the differences as shown between the drawings of *dalli* and the photographs of *truei*, and also on the disparity in the measurements of the caudal region. The variance in shape is in part the result of differences in the position of the specimens as represented in the illustrations. It is important to bear in mind the fact that *dalli* is represented by drawings which are crudely reproduced and are not as accurate in detail as photographs. Probably the artist or the engraver exaggerated the thinness of the keels on the caudal peduncle to make them appear more fin-like than they actually were. To us there appear to be no important differences between *dalli* and *truei* in the shape of the caudal peduncle, as shown in the drawings and photographs, when these factors are taken into account.

There is an obvious discrepancy between *dalli* and *truei* in the measurements of the caudal peduncle, but this is the result of error and perhaps of differences in methods of measurement. In a streamlined and rubbery animal such as the porpoise it is difficult to find many fixed points of measurement. Andrews (p. 35) gave the depth of the body 24 inches anterior to the insertion of the flukes as 535 millimeters for *truei* and 254 mm for *dalli*. That the measurement for *truei* is an obvious error can be determined by measuring the photographs and calculating the proportions. It should be near 350 mm instead of

535 mm. The greatest depth of *truei*, including the dorsal fin, is only about 500 mm, as calculated from figure 1 on plate I, and probably would be no more than 535 mm, without the compression caused by the weight of the animal, as may be judged by comparison with the difference in depth of our specimen as measured in the suspended position and when supported on the ventral surface. By applying the same method to the drawing of *dalli* it is found that the depth at 24 inches in front of the insertion of the flukes is 348 millimeters (or $13\frac{11}{16}$ inches) instead of 254 mm, as given by True. True states that this point is at the "highest point of keel," which is not so, as judged from the drawing. At the highest point of the keel the depth of body is calculated to be about 240 millimeters (or $9\frac{7}{16}$ inches), an approximation to the figure given by True. This is at a point about 312 mm (or $12\frac{1}{2}$ inches) anterior to the flukes. At this point *truei* is approximately 260 millimeters deep. Possibly there was an error in stating the point at which the measurement was made. The great value of photographs in illustrating important specimens is shown here. If it were not for the excellent photographs of *truei* published by Andrews it would not have been possible to reconcile the discrepancies between the stated measurements, and the error would have persisted.

We suggest that the dorsal and ventral prominences on the caudal peduncle serve as stabilizers working in a plane perpendicular to that of the flukes.

SKULL

The skulls of the two specimens in the Museum of Vertebrate Zoology, aside from minor characters attributable to individual variation, are like those of *truei* and *dalli*.

The following measurements in millimeters were made for comparison with those recorded by True and Andrews. However, as we could not determine from what points some of their measurements were made, we have omitted the most doubtful ones. The measurements, in millimeters, refer respectively to the adult male from San Francisco Bay, California, (no. 94751) and to a younger individual, probably a female, from Mole Harbor, Alaska, (no. 4755): Total length, 340, 318; length of beak from base of notches (measured along midline), 138, 132; breadth of beak at base of notches, 95, 90; breadth of beak at its middle, 60, 53; breadth of intermaxillaries at same point, 35, 27; greatest breadth between outer margins of intermaxillaries proximally, 55, 54; greatest breadth of skull (squamosal), 193, 178; tip of beak to anterior margin of superior nasal opening, 190, 185; breadth between orbital processes of frontal, 173, 154; breadth between hinder margins of temporal fossae, 173, 161; total length of mandible, 262, 254; depth between angle and coronoid process, 62, 64.

TEETH

True (1885, p. 98) gives the dental formula of *P. dalli* as $\frac{23\text{-}23}{27\text{-}27}$. Andrews (1911, p. 41) gives the dental formula of *P. truei* as $\frac{19\text{-}19}{22\text{-}22}$, but adds that he may

have missed some small teeth buried in the gums. In our specimen most of the teeth were missing. In each ramus of the lower jaw there were 18 pits in which teeth presumably had once been present, although none was found in these pits on dissection; there were, however, 4 minute teeth buried in the gums at the proximal end of each toothrow. On the right side of the upper jaw there were 15 pits, ten of which contained teeth, and on the left side there were 16 pits, seven of which contained teeth. The missing teeth on the right side were numbers (counting the pits from the front) 5, 6, 7, 8, 13; and on the left, 1, 5, 6, 7, 8, 9, 10, 13, 14. It was obvious from the condition of the gums that the teeth were missing from the area subject to greatest wear. The teeth present were only loosely fastened and could easily be lost in use. No teeth were found buried in the gums at the posterior ends of the upper toothrows, but it is possible that some may have been overlooked because of their small size. The maximum dental formula is $\frac{4}{4}$ which approaches the formula of *P. truei* rather than that of *P. dalli*.

Miller (1929) described the teeth of *P. dalli* as ensconced in pits in the gums, which themselves have been modified into gum teeth to take the place of the true teeth, which do not appear above the gums. Miller was not sure that *P. truei* had similar gums and teeth and quoted Andrews' description of *P. truei* to the effect that the teeth projected slightly above the surrounding membrane. In our specimen, which was observed while fresh, the teeth were as high as the ridge of gum teeth and were located along its inner edge.

A further discrepancy between our specimen and those described by Miller, is that in ours the palate and gums were much less rugose, although the gum teeth were plainly visible. Possibly the differences resulted from the method by which Miller's specimens were preserved. Otherwise a considerable amount of variation in these structures is indicated. It is obvious that the teeth in this species are rudimentary.

SKELETON

The vertebrae in our specimen closely resemble those figured by Andrews (1911) and by Miller (1930). The vertebral formula is variable, as is shown in the following table:

	CERVICALS	DORSALS	LUMBARS	CAUDALS	TOTAL	CHEVRONS
Type of *dalli*	7	14 (or 15)	27	49	97 (or 98)	30
Type of *truei*	7	17	25	46	95	35
No. 219334 U.S.N.M.	7	17	24	44	92	23
No. 238083 U.S.N.M.	7	18	—	—	—	25
No. 574 S.B.M.N.H.	7	17	26	44	94	32
No. 94751 M.V.Z.	7	18	24	44	92	35

Data concerning the types of *dalli* and *truei* were obtained from the original descriptions. Dr. Remington Kellogg supplied the data concerning the specimens in the National Museum, and Mr. E. Z. Rett gave us the data on the specimen in the Santa Barbara Museum.

There is perfect agreement only in the counts of the cervicals. These vertebrae are fused and are not subject to individual loss. Variation in the counts of the other groups results from actual variation in the individuals and possibly also from loss of vertebrae and identifying elements (ribs and chevron bones) in the course of preparation of the specimens.

We have based the counts of the dorsals on the numbers of pairs of ribs, not on the structure of the vertebrae. In this genus there is usually a distinct break in structure between the 16th and 17th, or 17th and 18th, vertebrae of the dorso-lumbar series. The anterior vertebrae have short transverse processes bearing distinct facets for articulation with the ribs; the posterior ones have much longer transverse processes and poorly defined articulating surfaces for ribs. Yet one or two of these lumbar-shaped vertebrae may bear ribs, which are variable in degree of development.

The number of dorsals, based on the number of ribs, varies from 17 to 18. True, who gave the number as 14 or 15 for *dalli*, was uncertain as to the exact number because it was thought that one vertebra might have been destroyed when the animal was harpooned. Possibly, therefore, this count was based on the structure of the vertebrae rather than on the number of pairs of ribs, for it is not likely that a harpoon would destroy the ribs and vertebra together. It may be, however, that the doubt was based on the presence of an extra pair of ribs. We think it most likely that the count was based on the structure of the vertebrae and that there were several more pairs of ribs than this number, a circumstance that would bring the count into close agreement with the others. The count of 42 or 43 in the dorso-lumbar series of *dalli* falls within the range (41 to 43) of the other specimens. Unfortunately, True did not mention the numbers of pairs of ribs for *dalli*. Andrews gave 16 as the number of dorsals in *truei*, but he counted as dorsals only those vertebrae with short (relatively to the lumbars) transverse processes bearing distinct facets for articulation with ribs. He found 17 pairs of ribs, the last of which he described as short and unattached to vertebrae or the sternum. In our specimen, 17 of the dorsals have short transverse processes. The 18th is shaped like the lumbars and bore a pair of long, slender ribs. Dr. Remington Kellogg writes that in no. 219334 U.S.N.M. the ribs of the 17th pair are reduced to short splints, and that in no. 238083, a female, there are 18 pairs of ribs, the last one of which is not so reduced as in the other specimens. Also, in this specimen, the 17th and 18th dorsals have prezygapophyses and long transverse processes, and the facets on the transverse processes for articulation with the ribs are not well defined. Mr. E. Z. Rett writes that the last rib-bearing vertebra in the Santa Barbara specimen is shaped like the other dorsals except that the transverse processes, which bear distinct facets, are 20 mm longer than those on the vertebrae preceding it; this is evidently an intermediate condition.

The lumbars apparently vary from 24 to 27 in number. We include as lumbars only those vertebrae that bear neither ribs nor chevron bones. As there are no sacrals in cetaceans, the first caudal is distinguished from the last lumbar by the presence of a chevron bone. The count of lumbars may be influenced by the treatment of the skeleton in preparation, because ribs and chevrons are

easily displaced and the corresponding vertebrae may not bear obvious facets for articulation. The most trustworthy counts are those made before the elements are disarticulated, as was done by Andrews with the type of *truei*. Our specimen was not completely disarticulated in cleaning, and the count is accurate. The other specimens were completely disarticulated and then reassembled and in some instances it is evident that elements were lost in the process. There are 25 lumbars in *truei* (Andrews gives 26, but we have assigned one of them to the dorsals because of the presence of the extra pair of ribs), and 24 in our specimen. True gives the maximum count of 27 for *dalli*, but, as already indicated, we think that one or two of these might really have been dorsals.

The caudals range from 44 to 49. The maximum is given by True for *dalli*. Andrews gives 46 for *truei*. All the other counts are 44. In our specimen the last vertebra is free. True states that the four terminal vertebrae were united in *dalli*, and Andrews states that in *truei* the terminal caudal was small and composed of two ankylosed portions.

The counts of the chevron bones are highly variable, but the lowest counts are the results of loss. Kellogg writes that the chevron series are not complete in the National Museum specimens. Otherwise the range is from 30 to 35. In our specimen the first chevron is represented only by the segment of the right side, and this segment is fused with the corresponding part of the second chevron (see figure 6). The left half of the second and the two halves of the third are free; all the rest are united. It is obvious that the anterior chevrons are variable and, therefore, that the counts of lumbars and caudals may be influenced by this variation.

The scapula in our specimen is relatively and actually broader than that figured by Andrews (p. 49) for *truei*. Also, the acromion in ours is longer and more slender (see figure 5). As far as can be judged from photographs, it most resembles the acromion in *dalli* as figured by Miller. Until additional material is available, we believe it best to regard these differences as individual variations.

The manus closely resembles that of *truei* as figured by Andrews. Unfortunately, some of the distal phalanges in our specimen were disarticulated before the phalangeal counts were made so that the phalangeal formula cannot be given with absolute certainty. The formulae for *dalli* and *truei* respectively are I, 1; II, 6; III, 4; IV, 2, and I, 1; II, 6; III, 5; IV, 2. Our specimen has but one phalanx on the first digit. There are enough (five) loose phalanges on the left manus to allow a formula of 6 for the second digit and 4 for the third. The fourth digit appears to have but one phalanx. Our specimen differs from the types of both *truei* and *dalli* in that the manus bears a fifth digit represented by one flattened phalanx of circular shape about 6 mm in diameter. This bone is present on both flippers and is still embedded in cartilage so that its presence in that position is definite. The probable phalangeal formula of our specimen is I, 1; II, 6; III, 4; IV, 2; V, 1. The phalangeal formula of the species is variable because of the rudimentary nature of the terminal phalanges, some of which are only 2 mm in diameter.

NOMENCLATURE

The Dall porpoise was first described as *Phocaena dalli* by True (1885) who based its inclusion in this genus chiefly on the shape of the teeth and the form and position of the pterygoids. He pointed out that the main features in which it differed from other members of the genus were the coloration, the shape of the dorsal fin, and the number of vertebrae. Andrews (1911), in describing a new porpoise from Japan, used these characters as diagnostic for a new genus (*Phocoenoides*), based on *Phocoenoides truei* as the type. He also used the great height of the dorsal spines of the vertebrae as a diagnostic character. He referred *dalli* to this genus although the structure of the vertebrae in *dalli* was not known at that time. Since then, Miller (1930) has shown that the skeleton of *dalli* is similar to that of *truei*, thus confirming Andrews' supposition of close relationship between these forms. Subsequently it has been suggested by several writers that *truei* and *dalli* were identical. Thus Ogawa (1938, p. 218), in a list of toothed whales observed by him in Japan, records *P. truei* as very common in Japanese waters and also records *P. dalli* as having been added by him to the Japanese fauna, with the comment that *dalli* appeared to him to be identical with *truei*.

We believe that the evidence available at present justifies the recognition of only one form. This involves regarding *P. truei* as a synonym of *P. dalli*. Andrews stated (p. 36) that the skulls of *truei* and *dalli* resembled one another so closely that he did not consider the differences in the skulls to be of specific importance. He did not know if *dalli* resembled *truei* in skeletal characters. These are now known to be similar. The external characters given by Andrews as points of difference between *dalli* and *truei* are the color pattern and the shape of the caudal region. Our specimen is intermediate between the two in color characters, and this fact, because the condition cannot represent intergradation in the geographical sense, is evidence that the differences in color are expressions of individual variation. This is borne out by Ogawa's statement that both kinds of porpoises occurred in Japanese waters. Presumably his "kinds" were based on coloration since the skull and skeleton are similar. We have already indicated our belief that there is no difference between *truei* and *dalli* in the shape of the caudal peduncle.

There is not enough evidence available as yet to indicate the status of the Dall porpoise as an inhabitant of California waters. It may be a sporadic visitor; it may be a seasonal visitor, although the dates (June and October) prove nothing definite as to season; or it may even be a permanent resident, though rare. The porpoises of the Pacific Coast have not been studied enough to be certain of any of these points. The only other evidence which might concern the presence of the Dall porpoise in San Francisco Bay is that while hunting bay porpoises (*Phocaena phocoena*) near Point Richmond in 1939, one of us (Benson) saw a porpoise marked with white on the sides. This was not thought at the time to be anything but an aberrantly-colored *Phocaena*, as it may well have been.

LITERATURE CITED

ANDREWS, R. C. 1911. A new porpoise from Japan. Bull. Amer. Mus. Nat. Hist., vol. 11, art. 4, pp. 31–52, 23 figs., 2 pls.

ANONYMOUS. 1925. A porpcise from the channel. Santa Barbara Mus. Nat. Hist., August, 1925, p. 6.

——— 1925. The porpoise again. *Ibid.*, October, 1925, p. 4.

LYON, M. W., JR., and OSGOOD, W. H. 1909. Catalogue of the type-specimens in the United States National Museum, including the Biological Survey Collection. Bull. U. S. Nat. Mus., vol. 62, pp. x + 325.

MILLER, G. S., JR. 1929. The gums of the porpoise Phocoenoides dalli (True). Publ. no. 2771 from Proc. U. S. Nat. Mus., vol. 74, art. 26, pp. 1–4, pls. 1–4.

——— 1930. A note on the skeletons of two Alaskan porpoises. Publ. 3107, Smiths. Misc. Coll., vol. 82, no. 13, pp. 1–2, 1 pl.

NICHOLS, J. T. 1927. Impressions of Alaska,—where East and West approximate. Natural History, vol. 26, no. 6, pp. 605–613, ills.

OGAWA, T. 1938. Studien über die Zahnwale in Japan, insbesondere über die vier bei uns bisher unbekannten Gattungen Tursiops, Steno, Pseudorca und Mesoplodon. Arbeiten aus dem Anatomischen Institut der Kaiserlich-Japanischen Universität zu Sendai. Heft 21, pp. 173–218, 29 abb. auf 14 Taf.

TRUE, F. W. 1885. On a new species of porpoise, Phocoena dalli, from Alaska. Proc. U. S Nat. Mus., vol. 8, pp. 95–98, pls. 2–5.

——— 1889. Contribution to the natural history of the cetaceans, a review of the family Delphinidae. Bull. U. S. Nat. Mus., vol. 36, pp. 1–191, 47 pls.

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GEOGRAPHIC VARIATION IN THE CANYON MOUSE, *PEROMYSCUS CRINITUS*

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An attempt to assign subspecific names to Nevadan specimens of *Peromyscus crinitus* led us to review material at hand of all the races of this species. This has been profitable because of the large number of study specimens accumulated since Osgood (North Amer. Fauna, no. 28) revised these mice in 1909. Study of this more adequate material better shows the geographic range of the species and of each of the several races and it gives an improved knowledge of the geographic variation otherwise.

The species may be characterized as comprising mice of a size small for the genus; tail longer than head and body except in occasional individuals in the northern part of the range of the species; fur plumbeous basally, succeeded by ochraceous and tipped with brownish or blackish; tail bicolored (except in race *delgadilli*), dark above and light below; tail relatively heavily haired in northern races; ear measured from notch on fresh specimens about as long as hind foot; sole of hind foot naked to distal end of calcaneum; mammae in two pairs, both inguinal; skull with short toothrow, relatively long slender rostrum; width across anterior part of zygomatic arches less than greatest breadth of braincase; premaxillae not extending behind nasals; M^1 and M^2 with or without accessory

cusps between the three principal labial cusps. *P. crinitus* currently, and probably correctly, is placed in the subgenus *Haplomylomys* Osgood, but the presence of accessory cusps in the upper molars of some individuals, the presence of hairs on part of the sole of the hind foot, and some other features show the relationship of *crinitus* to the subgenus *Peromyscus* Gloger, and cause *P. crinitus* to be regarded as a species intermediate between the two subgenera or as an aberrant member of the subgenus *Haplomylomys*.

The range of *P. crinitus* is limited on the west by the Sierra Nevada-Cascade monntain chain, except along the Kern River drainage in California, and on the east by the Rocky Mountains. Latitudinally, the range is from near 45° N in Oregon, south to near 30° N in Lower California, Mexico (see fig. 1). Altitudinally, the mice occur from 10,600 feet at Bullfrog Lake, Fresno County, California, down to 280 feet below sea level in Death Valley of the same State. Zonally, they range from within the Transition Life-zone down through the Upper Sonoran Life-zone into the Lower Sonoran Life-zone. The habitat is sharply restricted in that the mice live among rocks. It follows that their geographic range is highly discontinuous; the mice are absent from areas lacking rocks. Because the species is made up of many isolated populations, the mice would be expected to show great diversity in characters such as appear in populations of many other species that are restricted to rocky places. Ordinarily the isolated populations of these species show marked response to environmental factors. This expected diversity in *P. crinitus*, in a degree, is realized, for the color of the pelage in several populations closely matches the color of the rocks where they live. For example, animals black above, or nearly so, occur among black rocks near Prineville, Oregon, at Indian Well Cave (Siskiyou County), California, near St. George, Utah, and in northwestern Sonora. Some other areas of dark-colored rocks, nevertheless, are inhabited by canyon mice of a color normal for the surrounding area. Furthermore, in features other than color of pelage, no such positive response to characters of the local environment has been detected. Instead, the other variations are more nearly of a geographic nature, as explained in the second paragraph beyond, and much of the variation in color itself behaves in this manner.

For example, all across the northern part of the Great Basin the mice are dark colored. In all the territory from northeastern Arizona and northwestern New Mexico, northward to southern Wyoming the bright Ochraceous-Buff color is maintained in uniform fashion. In the intervening region comprising the former basin of Lake Bonneville, all the mice are light gray in color. Except in color, geographic variation is discernible chiefly in (1) the proportional relation between the length of tail and the length of head and body and (2) in actual size. The latter is revealed in weight of the animal and length of its body, tail, and skull. Study of the skull reveals some variation of a geographical nature, as set forth in some of the accounts of subspecies beyond, but relatively little as compared with some other mice of similar size. A cline is evident in each of several features and reflects a gradual, relatively constant, trend from north to south, except that in the Lower Sonoran Life-zone from about 35° to 30° N, there is relative uniformity. The northern animals are

heaviest, have longest bodies, shortest tails, longest skulls, and distinctly longer hair on the tail.

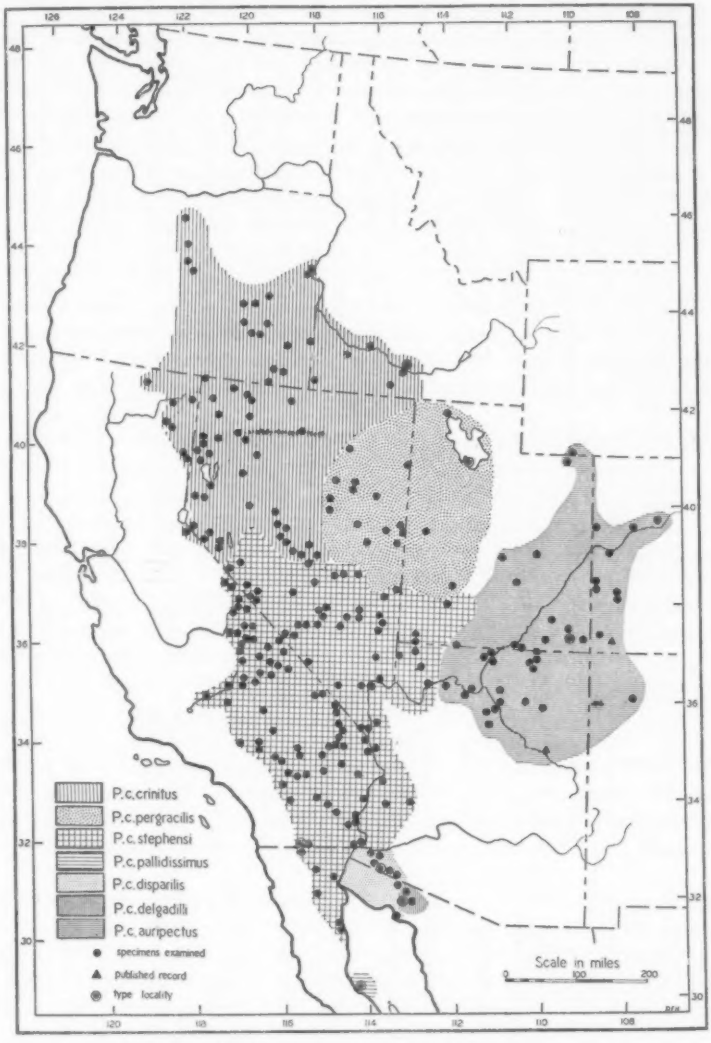

FIG. 1. Map showing geographic races of *Peromyscus crinitus*

The term geographic variation in the present instance is employed to include features that are relatively constant over areas of considerable extent (for example gray color of *pergracilis*, and long tail of *disparilis*), and to exclude any

TABLE 1.—*Average and extreme measurements, in millimeters, of adults of Peromyscus crinitus*

	TOTAL LENGTH	LENGTH OF TAIL	RATIO, TAIL TO HEAD AND BODY	LENGTH OF HIND FOOT	LENGTH OF EAR FROM NOTCH	GREATEST LENGTH OF SKULL	BASILAR LENGTH	GREATEST BREADTH OF BRAINCASE	INTERORBITAL CONSTRICTION	LENGTH OF NASALS	SHELF OF BONY PALATE	LENGTH OF PALATINE SLITS	DIASTEMA	POSTPALATAL LENGTH	ALVEOLAR LENGTH OF MAXILLARY TOOTHROW
P. c. crinitus, 9, ♂♂, 8 mi. W Rogerson, Twin Falls Co., Idaho	180 175–188	92 88–95	105	20.0 18–21	18.6 17–20	25.0 24.3–25.6	18.2 17.7–18.8	12.0 11.5–12.3	4.2 4.1–4.6	9.6 9.4–9.9	4.1 3.8–4.3	5.1 4.8–5.4	6.2 5.8–6.6	8.7 8.4–9.4	3.6 3.4–3.8
P. c. pergracilis, 9, ♂♂, vicinity Mount Moriah, White Pine Co., Nevada	172 165–186	89 82–97	107	20.1 19–21	19.6 18–21	24.9 24.4–25.5	18.3 17.9–19.0	11.8 11.5–12.1	4.3 4.1–4.9	9.4 8.7–9.9	3.8 3.5–4.2	5.0 4.6–5.4	6.1 5.8–6.3	8.6 8.4–8.8	3.5 3.3–3.6
P. c. stephensi, 5, ♂♂, topotypes	170 163–176	97 94–99	133	19.5 18.7–20	18.7 18–19	23.8 23.1–24.1	17.4 17.1–17.7	11.3 11.1–11.5	3.9 3.8–4.1	8.9 8.8–9.2	3.4 3.2–3.6	4.9 4.7–5.1	5.9 5.8–6.1	8.3 8.0–8.6	3.3 3.2–3.5
P. c. pallidissimus, 1, ♂, topotype	187	110	143	21	—	24.6	17.5	11.5	4.0	9.1	3.3	5.1	5.9	8.5	3.6
P. c. disparilis, 5, ♂♂, topotypes	185 179–192	111 107–118	150	19.6 18–21	20 —	23.8 23.6–24.2	17.2 16.9–17.7	11.3 11.1–11.6	3.9 3.8–4.0	8.9 8.8–9.1	3.5 3.4–3.6	5.1 4.8–5.3	5.7 5.5–6.0	8.3 8.2–8.5	3.5 3.5–3.6
P. c. delgadilli, 3, ♂♂, topotype, 1, Crater Elegante, 1, and Batamote, 1, Sonora	185 181–188	106 94–115	134	20.7 20–21	19.7 19–20	24.0 23.8–24.4	17.7 17.5–18.1	11.2 11.0–11.5	4.0 3.9–4.1	9.0 8.9–9.1	3.4 —	5.3 5.2–5.4	6.0 5.8–6.1	8.5 8.3–8.7	3.6 —
P. c. auripectus, 6, ♂♂, topotypes	175 170–183	92 88–96	111	21.7 21–23	—	25.9 25.3–26.5	18.5 18.2–19.0	12.4 12.3–12.6	4.5 4.5–4.7	10.0 9.4–10.5	3.7 3.5–3.8	5.4 5.1–5.7	6.4 6.1–6.7	8.9 8.8–9.1	3.7 3.6–3.9
P. c. crinitus, 5, ♀♀, 8 mi. W Rogerson, Twin Falls Co., Idaho	176 170–179	93 89–96	112	20.3 20–21	19.3 19–20	25.0 24.4–25.5	18.3 17.8–18.7	12.1 11.8–12.4	4.2 4.2–4.3	9.4 9.2–9.8	4.2 4.1–4.4	5.0 5.0–5.2	6.3 6.2–6.5	8.6 8.3–8.9	3.5 3.5–3.7
P. c. pergracilis, 11, ♀♀, vicinity Mount Moriah, White Pine Co., Nevada	173 164–186	90 86–96	108	19.6 18–21	19.6 18–21.5	25.0 23.5–25.5	18.2 17.1–19.1	11.9 11.5–12.2	4.3 4.1–4.5	9.5 8.6–9.9	3.8 3.5–3.9	5.0 4.7–5.3	6.1 5.7–6.5	8.7 8.2–9.2	3.5 3.2–3.6
P. c. stephensi, 4, ♀♀, topotypes and 3 miles east of type locality	169 165–173	96 —	131	18.5 18–19	17.0 —	23.5 23.0–23.8	17.2 17.0–17.4	11.1 10.9–11.4	4.0 3.9–4.1	8.9 8.8–9.0	3.5 3.1–3.8	4.7 4.2–5.0	5.8 5.6–5.9	8.2 8.0–8.4	3.3 3.1–3.6
P. c. disparilis, 5, ♀♀, topotypes	180 169–188	107 99–113	147	18.8 17.5–20	20.0 19–21	23.6 23.2–24.2	17.1 16.7–17.6	11.1 10.9–11.2	3.9 3.8–3.9	8.8 8.7–9.0	3.5 3.2–3.6	5.1 4.9–5.2	5.7 5.5–6.0	8.2 8.0–8.4	3.4 3.4–3.5
P. c. delgadilli, 1, ♀, topotype	183	108	142	20	21	24.0	17.8	11.2	4.0	9.1	3.5	5.1	6.1	8.6	3.6
P. c. auripectus, 2, ♀♀, topotype and Aneth, San Juan Co., Utah	178 172–183	93 86–100	109	22 21–23	—	26.0	18.3 17.8–18.7	12.2	4.6	10.1	3.6	5.3 5.2–5.4	6.3 6.0–6.5	8.8 8.7–8.9	3.7 3.6–3.8

feature that characterizes only small populations that are widely separated by mice of a different appearance (for example, black color of upper parts at Prineville, Oregon, and at Indian Well Cave, California). The behavior of the feature geographically, and not its nature or its cause, is the criterion for designating a feature (variation) as geographic or nongeographic.

Intergradation in the sense of modification of a structure or color by intermediate steps from the condition in one geographic race to that in another occurs between races whose ranges are contiguous, with two exceptions. One exception is comprised in the black *delgadilli* and the other in *pallidissimus*.

Some secondary sexual variation exists in this species. The females, on the average, exceed the males in size. The difference in this respect is indicated by the following average measurements of 15 adults of each sex of *P. c. pergracilis* from White Pine County, Nevada: Total length, ♂, 171 mm, ♀, 177; weight in grams, ♂, 16.6, ♀, 19.5; greatest length of skull, ♂, 24.8, ♀, 25.3. The females exceed the males by 3.5 per cent in total length, 17.5 per cent in weight, and 2.1 per cent in greatest length of skull. This average difference is less than the range of individual variation in animals of the same sex and age from one locality.

Our methods of study included segregation of specimens by sex, segregation of each sex by age, and segregation of each age, of each sex, by season or stage of molt. Measurement was made of degree of individual variation in one of these selected groups and comparisons designed to test for geographic variation were made only between series of specimens of like sex, age, and season from different places. The variation detected, with allowance for individual variation, was regarded as geographic variation. For each geographically variable feature noted, a map was prepared for animals of each sex. Thus it was possible to study each variable feature in all parts of the range of the species. In all, 12 such maps were made. The assignment of geographic ranges to subspecies is more easily accomplished on some of these maps than on the one map comprising fig. 1 where an attempt is made to codify all the data. Only adult animals were relied upon in the final study. The criterion of adulthood accepted was some wear upon each major cusp of each cheek tooth. All animals with the teeth this much worn were in adult pelage. Capitalized color terms are after Ridgway (Color Standards and Color Nomenclature, Washington, D. C., 1912).

Cranial measurements used were taken as by Osgood (North Amer. Fauna, no. 28, 1909). The greatest breadth of braincase was measured across the parietals at the point of greatest bulge just posterior to the zygomatic process of the squamosals. External measurements are those taken by the collectors.

In all, we have examined 1214 specimens. A specimen normally consists of a cleaned skull, stuffed skin, and collector's label giving essential data including external measurements of the animal. Of these specimens, 1060 are in the California Museum of Vertebrate Zoology. For the loan of the additional specimens we thank: Clinton G. Abbott and Laurence M. Huey of the San Diego Society of Natural History; Glover M. Allen of the Museum of Com-

parative Zoology; William H. Burt and Emmet T. Hooper of the Museum of Zoology, University of Michigan; Ralph Ellis of Berkeley, California; Reed W. Fautin, Brigham Young University, Utah; Donald V. Hemphill, Pacific Union College, California; Edward A. Goldman and Hartley H. T. Jackson of the United States Fish and Wildlife Service; Stanley G. Jewett of Portland, Oregon; Remington Kellogg and Gerrit S. Miller, Jr., of the United States National Museum; and Edward R. Warren, Colorado Springs, Colorado. We are especially grateful to Miss Annie M. Alexander and Miss Louise Kellogg who obtained specimens at a number of critical places including the type localities of *P. c. auripectus*, *P. c. disparilis*, and *P. c. stephensi*.

No new names are proposed by us. We find a total of 12 names available for the 7 races here recognized.

Peromyscus crinitus crinitus (Merriam)

Hesperomys crinitus Merriam, North Amer. Fauna, no. 5, p. 53, July 30, 1891.
[*Peromyscus Truei*] *crinitus*, Trouessart, Catal. Mamm. viv. foss., p. 517, 1897.
Peromyscus crinitus scitulus Bangs, Proc. New England Zool. Club, vol. 1, p. 67, July 31, 1899. Type from Gardnerville, Douglas County, Nevada.

Type.—Adult male, no. 24255/31659, U. S. Nat. Mus., Biol. Surv. coll., skin with skull; Shoshone Falls, north side Snake River, Jerome County, Idaho; October 10, 1890; collected by C. H. Merriam and V. Bailey; original no. 1945. Type not seen by us.

Range.—Oregon east of the Cascades, southwestern Idaho east to Shoshone Falls, south through northeastern California and western Nevada to latitude of Walker Lake. See figure 1.

Diagnosis.—Body long (see measurements); tail short, averaging about 107 per cent of length of head and body; upper parts near (*j*) Hair Brown in general effect but mixed with some ochraceous; underparts white; tail dusky above; feet white; skull medium sized; shelf of bony palate long.

Comparisons.—Differs from *pergracilis* in slightly longer body and tail, notably darker color, and the shelf of the bony palate averages longer. From *P. c. stephensi*, *crinitus* differs in larger size of all parts measured except length of tail, which is less, and ear, which is about the same; notably darker color; tail with longer hairs; shelf of bony palate relatively as well as actually longer; zygomatic arches relatively wider anteriorly.

Remarks.—The type locality of this race, recorded by the describer (Merriam, North Amer. Fauna, no. 5, p. 53, July 30, 1891) as "Shoshone Falls," has been more precisely located by Davis (The Recent Mammals of Idaho, p. 72, Caxton Printers, Ltd., April 5, 1939) as on the north side of the Snake River.

The northernmost locality of occurrence for this race, and for the entire species, is Maupin, Oregon, only 35 miles south of the Columbia River. The large series of specimens taken by S. G. Jewett, at Prineville, Oregon, in 1915, agrees well with topotypes. Of 3 other specimens taken by him 5 years later, and labeled as from Prineville, one differs in darker color. Even its underparts, instead of being whitish, are plumbeous, heavily and uniformly overlain with buff. This dark specimen, no. 986 S. G. J., is one of 4 from Prineville referred to *Peromyscus truei preblei* by Bailey (North Amer. Fauna, no. 55, p. 188, 1936), when he named that subspecies. All four of the specimens prove upon examination to be *Peromyscus crinitus crinitus*. From Indian Well Cave, California, the westernmost locality of occurrence for the race, and for the entire species, the mice are darker colored above than any other adults that we have seen. These are from an area of black lava. Except in color, all of these black specimens agree well with other specimens of *P. c. crinitus* from the same latitude.

Peromyscus crinitus scitulus Bangs was regarded by Osgood (North Amer. Fauna, no. 28,

p. 229, 1909) as a synonym of *P. c. crinitus*. Our own examination of the topotypes used by Bangs, and our study of other specimens from nearby, leads us to agree. Nevertheless, animals from this area differ from those of northern populations of *crinitus* and from *stephensi* taken near the center of its range. These topotypes and other specimens from the same general area of Nevada are intermediate in color and size of skull. In these features they show greater resemblance to *crinitus* with which they agree in other features relied upon to distinguish the two races concerned.

Geographic variation otherwise is shown by specimens from western Nevada, assigned to *crinitus*, in that the tail is actually shorter than in either *crinitus* to the north or in typical *stephensi* to the south. Mice in this area, therefore, are, on the average, differentiated by the short tail. Usually it is only a little longer than the head and body; sometimes it is less. In these mice the skulls are smaller than in typical *crinitus* to the north but they average larger than skulls of *stephensi* from near the center of its range. This and other features as displayed by populations from the southern part of the geographic range assigned to *crinitus* and the northern part of the range assigned to *stephensi* show intergradation between the two subspecies.

Specimens examined.—Total number, 263, from the following localities: **Oregon:** *Wasco Co.:* Maupin, 3 (U. S. Nat. Mus., Biol. Surv. coll.). *Jefferson Co.:* Haycreek, 1 (U. S. Nat. Mus., Biol. Surv. coll.). *Crook Co.:* Prineville, 10 (3 in coll. S. G. Jewett; 7 in U. S. Nat. Mus., Biol. Surv. coll.); Crooked River, 20 mi. SE Prineville, 2 (U. S. Nat. Mus., Biol. Surv. coll.). *Baker Co.:* 3 mi. NE Huntington, 2100 ft., 1 (U. S. Nat. Mus., Biol. Surv. coll.); Huntington, 2100 ft., 2 (U. S. Nat. Mus., Biol. Surv. coll.). *Harney Co.:* Drewsey, 1 (U. S. Nat. Mus., Biol. Surv. coll.); Harney, 4 (U. S. Nat. Mus., Biol. Surv. coll.); Burns, 2 (U. S. Nat. Mus., Biol. Surv. coll.); Narrows, 1 (U. S. Nat. Mus., Biol. Surv. coll.); Malheur Cave, 4000 ft., 2 (U. S. Nat. Mus., Biol. Surv. coll.); Diamond, 4300 ft., 3 (U. S. Nat. Mus., Biol. Surv. coll.); Smyth Creek, 10 mi. E Diamond, 5500 ft., 2. *Malheur Co.:* Rocky Butte, Jordan Valley, 4600 ft., 2 (U. S. Nat. Mus., Biol. Surv. coll.); 1 mi. S Rome, 3600 ft., 1; Crooked Creek, Owyhee Desert, 4000 ft., 1 (U. S. Nat. Mus., Biol. Surv. coll.); head Crooked Creek, Owyhee Desert, 4000 ft., 1 (U. S. Nat. Mus., Biol. Surv. coll.); 21 mi. N McDermitt (Nevada), 5300 ft., 1; Disaster Peak (east base), 5600 ft., 1 (U. S. Nat. Mus., Biol. Surv. coll.). **Idaho:** *Elmore Co.:* 3 mi. NE Hammett, 3. *Owyhee Co.:* Castle Creek, 8 mi. S Oreana, 1; S fork Owyhee River, 12 mi. N Nevada line, 7. *Jerome Co.:* N side Snake River, Shoshone Falls, 2. *Twin Falls Co.:* S side Snake River, Shoshone Falls, 2; Salmon Creek, 8 mi. W Rogerson, 15. **California:** *Siskiyou Co.:* Indian Well (Cave and Blue Grotto), Lava Beds National Monument, 9. *Modoc Co.:* Dry Creek, Warner Mts., 4800 ft., 11; 10 mi. SW Alturas, 5000 ft., 1. *Lassen Co.:* Grasshopper Valley, 5400 ft., 1; 5 mi. N Fredonyer Peak, 5700 ft., 3; 1 mi. N Wendel, 2; 4½ mi. WNW Stacy, 1. *Alpine Co.:* 2 mi. NE Woodfords, 5600 to 5700 ft., 6. **Nevada:** *Washoe Co.:* 12-mile Creek, ¾ mi. E Calif. Boundary, 5300 ft., 2; Painted Point, 9 mi. E Vya, 6000 ft., 1; mouth of Little High Rock Canyon, 5000 ft., 1; 17½ mi. W Deephole, 4750 ft., 1; 17 mi. W Deephole, 4800 ft., 3; 1 mi. NE Gerlach, 4000 ft., 7; 13 mi. W and 9 mi. S Deephole, 3850 ft., 1; 40° 28′ N, 6 mi. E. Calif. Boundary, 4000 ft., 8; Horse Canyon, 3 mi. NW Pahrum Peak, 5000 ft., 1; N side Sand Pass, 3900 ft., 1; Sand Pass, 3950 ft., 1; 3½ mi. NW Flanigan, 4200 ft., 1; ½ mi. NW Flanigan, 4200 ft., 3; 2½ mi. E Flanigan, 4250 ft., 1; ½ mi. S Pyramid Lake, 3950 ft., 1; 1 mi. SW Pyramid Lake, 3950 ft., 1; 1 mi. S Pyramid Lake, 1; N side Truckee River, 10 mi. E Reno, 1; 15 mi. E Reno, 1; 3 mi. E Reno, 14. *Douglas Co.:* Gardnerville, 7 (Mus. Comp. Zoöl.); Carson River, 5 mi. SE Minden, 4900 ft., 4; Desert Creek, Sweetwater Range, 6250 ft., 8. *Lyon Co.:* W. Walker River, 12 mi. S Yerington, 4600 ft., 3. *Humboldt Co.:* Virgin Valley, 5000 ft., 2; head of Big Creek, Pine Forest Mts., 8000 ft., 1; Big Creek Ranch, Pine Forest Mts., 4350 ft., 2; 14 mi. N Paradise Valley, 6400 ft., 2; 1½ mi. N Quinn River Crossing, 4100 ft., 3; Jackson Cr. Ranch, 17½ mi. S and 5 mi. W Quinn River Crossing, 4000 ft., 1; 18 mi. NE Iron Point, 4600 ft., 2; 10 mi. W and 6 mi. N Sulphur, 4000 ft., 2. *Pershing Co.:* 3½ mi. SE Sulphur, 4950 ft., 4; El Dorado Canyon, Humboldt Range, 6000 ft., 4; 3½ mi. NE Toulon, 3950 ft., 1; 3½ mi. W Toulon, 4500 ft., 1. *Churchill Co.:* Mountain Well, 5600 ft., 5.

Mineral Co.: E. Walker River, 2 mi. NW Morgan's Ranch, 5050 to 5100 ft., 4; ¼ mi. N Wichman, 5500 ft., 5 (coll. D. V. Hemphill); Wichman, 5500 ft., 1 (coll. D. V. Hemphill). *Lander Co.:* 2½ mi. NE Smiths Creek Ranch, 5800 ft., 2; Peterson Creek, Shoshone Mts., 6500 ft., 1; Kingston Canyon, 7000 to 7100 ft., 6. *Nye Co.:* Ophir Creek, 6500 ft., 1; S. Twin River, 6500 ft., 13; Greenmonster Canyon, Monitor Range, 7500 ft., 1; 1 mi. NE Jefferson, Toquima Range, 7600 to 7650 ft., 7; 1 mi. E Jefferson, Toquima Range, 7600 ft., 5; 7 to 8 mi. E Toquima Peak, Monitor Valley, 7100 ft., 2; 4 mi. N Hot Creek, Hot Creek Range, 6400 ft., 3; 7 to 8 mi. W Tybo, Hot Creek Range, 6700 to 7200 ft., 4.

Peromyscus crinitus pergracilis Goldman

Peromyscus crinitus pergracilis Goldman, Jour. Mamm., vol. 20, p. 356, August 14, 1939.
Peromyscus [*crinitus*] *crinitus*, Osgood, North Amer. Fauna, no. 28, p. 231, April 17, 1909, part.

Type.—Old adult, unsexed, no. 264022, U. S. Nat. Mus., Biol. Surv. coll., skin with skull; [south end of] Stansbury Island [4250 ft.], Great Salt Lake, Tooele County, Utah; June 22, 1938; collected by William H. Marshall; original no. 100.

Range.—Eastern Nevada and western Utah, corresponding in general to the outlines of the Pleistocene Lake Bonneville. See figure 1.

Diagnosis.—Body long; tail short, averaging about 107 per cent of length of head and body; upper parts near (16′) Light Ochraceous-Buff, lightly overlain with dusky; underparts white; tail dusky above; feet white; skull of medium size.

Comparisons.—Differs from *auripectus* in smaller hind foot, notably paler (grayer) color, smaller skull except that shelf of bony palate is about the same or larger and hence relatively much longer. From *stephensi*, *pergracilis* differs in longer body, shorter more heavily haired tail, greater weight, larger skull in all parts measured and relatively longer shelf of bony palate. Comparison with *crinitus* has been made in the account of that form.

Remarks.—This race, named on the basis of a single aged individual in worn pelage, was judged by the describer to be restricted to Stansbury "Island," an area of land in Great Salt Lake not entirely isolated from the mainland. When adequate topotypical material is available, the describer's judgment may be substantiated. Our own careful comparison of the type with specimens from Mount Moriah, Nevada, reveals that every one of the differential characters ascribed to *pergracilis*, in the original description, is duplicated among the Nevadan specimens. Search by us for additional characters to distinguish the animal taken on Stansbury Island was in vain. It is true that no one of the Nevadan specimens shows exactly the same combination of characters as does the type of *pergracilis*, but no two Nevadan specimens exactly agree either. Therefore, we choose to employ the name *pergracilis* for all of the pale mice that have a distribution corresponding in a general way to the former basin of Lake Bonneville.

The specimens from White Valley, Utah, clearly are *pergracilis*. The three from Beaver River, farther southeast, are juveniles, and do not show diagnostic subspecific characters. Therefore, their reference to *pergracilis* is provisional.

The single adult from Kelton is slightly darker than most specimens of *pergracilis*. Possibly this indicates intergradation with *crinitus* as we assume does the darker color of specimens assigned to *pergracilis* from the eastern part of the geographic range in Eureka County, and the subadult from Elko.

Specimens examined.—Total number, 92, from the following localities: **Nevada:** *Eureka Co.:* Union, 1; 4 mi. S Romano, Diamond Valley, 7; 8 mi. W Eureka, 2. *Elko Co.:* Elko, 1 (U. S. Nat. Mus., Biol. Surv. coll.); 8 mi. S Wendover, 4700 ft., 6; W side Ruby Lake, 3 mi. N White Pine Co. line, 1 (coll. Ralph Ellis). *White Pine Co.:* W side Ruby Lake, 3 mi. S White Pine Co. line, 6100 ft., 5 (coll. Ralph Ellis); Cherry Creek, 6800 ft., 3; 2 mi. W Smith Creek Cave, Mt. Moriah, 6300 ft., 10; Deadman Creek, 6700 ft., Mt. Moriah, 3; near Smith Creek Cave, Mt. Moriah, 5800 to 7200 ft., 18; Halstead Creek, 1 mi. W Illipah, 6200 ft., 1; Cleve Creek, Shell Creek Range, 6900 ft., 7; Hendry Creek, 8 mi. SE Mt. Moriah, 6200 ft., 2; Baker Creek, 7300 to 7700 ft., 5; Water Canyon, 8 mi. N Lund, 5; Water Canyon, 10 mi.

N Lund, 1. **Utah:** *Box Elder Co.:* Kelton, 4225 ft., 2. *Tooele Co.:* Stansbury Island, Great Salt Lake, 1 (U. S. Nat. Mus., Biol. Surv. coll.). *Millard Co.:* White Valley, 8 (coll. R. W. Fautin). *Beaver Co.:* Beaver River (near Fort Cameron, see Osgood, North Amer. Fauna, no. 28, p. 231, 1909), 3 (U. S. Nat. Mus., Biol. Surv. coll.).

Peromyscus crinitus stephensi Mearns

Peromyscus stephensi Mearns, Proc. U. S. Nat. Mus., vol. 19, p. 721, July 30, 1897.

Peromyscus eremicus stephensi, Stephens, California Mammals, p. 109. West Coast Publishing Co., San Diego, California, 1906.

Peromyscus crinitus stephensi, Osgood, North Amer. Fauna, no. 28, p. 232, April 17, 1909.

Peromyscus [*crinitus*] *crinitus*, Osgood, North Amer. Fauna, no. 28, p. 229, April 17, 1909, part.

Peromyscus crinitis pallidissimus Huey, Trans. San Diego Soc. Nat. Hist., vol. 6, p 389, August 28, 1931, part.

Peromyscus crinitus peridoneus Goldman, Jour. Mamm., vol. 18, p. 93, February 14, 1937, part.

Peromyscus petraius Elliot, Field Columb. Mus., publ. 87, zool. ser., vol. 3, p. 244, December, 1903. Type from Lone Pine, Inyo County, California.

Type.—Adult female, no. 61026, U. S. Nat. Mus., skin with skull; lowest water on wagon road in canyon at eastern base of Coast Range, near Mexican Boundary [=3 miles east of Mountain Spring], Imperial County, California; May 9, 1894; collected by E. A. Mearns; original no. 3512. Type not seen by us.

Range.—Southern Nevada from about the latitude of Walker Lake, southwestern Utah, and western Arizona south to Gila River; southward through southeastern California and northeastern Lower California to San Felipe. See figure 1.

Diagnosis.—Body short; tail of medium length, averaging about 130 per cent of length of head and body in topotypes; weight about 12 grams; upper parts near (14′) Light Ochraceous-Buff, overlain with brownish and blackish; underparts white; tail dark brownish above; feet white; skull small; zygomatic breadth slight anteriorly.

Comparisons.—Differs from *pallidissimus* in actually and relatively shorter tail that is more densely haired, darker color, and longer skull. From *disparilis*, *stephensi* differs in actually and relatively shorter tail and grayer, less ochraceous color. Comparisons with *crinitus*, *pergracilis* and *delgadilli* are made in the accounts of those races.

Remarks.—The type locality as here given takes into account the findings of Howell (Jour. Mamm., vol. 4, p. 266, 1923) and Grinnell (Univ. California Publ. Zool., vol. 40, p. 171, 1933). *P. c. stephensi* intergrades with each of the adjoining subspecies. The intergradation with *crinitus* is in many features gradual over a wide area and as a result Nevadan specimens from the northern part of the range of *stephensi* approach *crinitus* in shorter tail, longer skull and in some other particulars which make them unlike topotypes of *stephensi*. Topotypes of *Peromyscus petraius* Elliot are of this nature. Similar approach morphologically, as well as geographically, is shown to *pergracilis* by specimens from several localities a little north of 38°N latitude in eastern Nevada, all referred to *stephensi*. These specimens are suggestive also of *crinitus* in coloration. Specimens from southwestern Utah and northwestern Arizona show intergradation with *auripectus* but are nearer *stephensi* in color and in size. At St. George, Utah, on rocks of a generally reddish color, most mice caught were typical of *stephensi* in color, but one is nearly black. Why some specimens here should be nearly black, others as light as typical *stephensi*, and still others of intermediate shades, we do not know.

The two specimens from Parowan are subadults, one of which has postjuvenal pelage. The pelage is intermediate between that of *pergracilis* and *auripectus*, and in addition shows some features characteristic of *stephensi*. In cranial measurements and in external measurements the two specimens are intermediate between *pergracilis* and *stephensi*. They are here referred to the latter.

Along the eastern side of the Colorado River, in Arizona, animals from Black Peak,

from 10 mi. E Quartzite, and from the Harquahala Mts., have tails that are actually and relatively longer than mice across the river directly to the west. This greater length of tail is an approach to, and suggests intergradation with, the even longer tailed *disparilis* from farther south on the same, eastern, side of the river.

One variation of the specimens from the three mentioned localities east of the river is their dark color. This is darker than in either *stephensi* or *disparilis* and led us to make repeated search for other correlated features that would give basis for separating them as a race distinct from either *stephensi* or *disparilis*. No such features other than color were found and we suppose that the dark color is a response to the environment, although we have no precise knowledge of the character of the latter. It should be noted that the few adult specimens from farther north (Hoover Dam Ferry, Mud Spring, and foot of the Needles) on the east side of the Colorado River, do not differ in relative (to head and body) length of tail from mice across the river directly to the west.

Huey (Trans. San Diego Soc. Nat. Hist., vol. 6, p. 390, 1931) referred specimens from San Felipe, Lower California, on the mainland, to *Peromyscus crinitus pallidissimus*. In external proportions, particularly length of tail relative to length of body, these do agree with *pallidissimus* and have relatively longer tails than topotypes of *stephensi*. In color these mainland animals show greater resemblance to *stephensi* to which they are here referred. The greater length of tail in the southernmost mainland populations is to be expected because, elsewhere within the range of *stephensi*, the tail averages shorter the farther north the locality of occurrence.

The only known records of occurrence from west of the crest of the Sierra Nevada are provided by two specimens from along the Kern River at Onyx and at the mouth of the canyon, and by a specimen from 1½ miles west of the crest at Bullfrog Lake. Each of these specimens agrees with others referred to *stephensi* from east of the Sierra Nevada at about the same latitude. Exception must be made for the length of tail (112 mm) in the specimen from Onyx, which is more than in other specimens of *stephensi* from the same latitude and about as in specimens from the southern part of the range of *stephensi*.

Specimens examined.—Total number, 654, from the following localities: **California**: *Fresno Co.:* Bullfrog Lake, 10,600 ft., 1. *Kern Co.:* Onyx, 2750 ft., 1; mouth Kern River Canyon, 15 mi. NE Bakersfield, 1 (U. S. Nat. Mus., Biol. Surv. coll.); 2 mi. N Sorrells Ranch, Kelso Valley, 4500 ft., 2. *Los Angeles Co.:* 2 mi. S Pecks Butte, 2650 ft., 2; Lovejoy Spring, 1. *Mono Co.:* Dutch Pete's Ranch, 4 mi. W Benton, 6482 ft., 2; Benton, 7; Taylor Ranch, Blind Spr. Hill, 2 mi. S Benton Station, 6200 ft., 1. *Inyo Co.:* Silver Canyon, 7 mi. E Laws, White Mts., 7000 ft., 11; Roberts Ranch, Wyman Creek, White Mts., 8250 ft., 1; Deep Spring Lake, 5000 ft., 3; Bishop Creek, 4½ mi. SW Bishop, 5000 ft., 2; Mazourka Canyon, 7700 ft., 11; Lead Canyon, Saline Valley (drainage), 4800 ft., 3; 3½ mi. E Lead Canyon (lava flow), Saline Valley, 3000 ft., 2; Kearsarge Pass, 6000 ft., 6; Walters Ranch, 2 mi. N Independence, 4; Independence, 3900 ft., 5; spring, Salt Works, Saline Valley, 1100 ft., 1; Fall Canyon, Grapevine Mts., 5600 ft., 7; 7 mi. N Lone Pine, 2; 2½ to 3 mi. W Lone Pine, 4; 1 mi. W Lone Pine Creek, 4500 ft., 4; Lone Pine Creek, 4500 ft., 10; Lone Pine, 1; Emigrant Spring, Panamint Mts., 4045 ft., 1; Echo Canyon, Funeral Mts., 1800 ft., 4; 4 mi. S Echo Canyon, Funeral Mts., 2300 ft., 2; Carroll Creek, 5500 ft., 1; 12 mi. N Darwin, near Lee Mine, 1; 1½ mi. SW Olancha, 3900 ft., 3; Wild Rose Canyon, Panamint Mts., 5000 ft., 28; Hanaupah Canyon, Panamint Mts., 4300 ft., 9; 280 feet below sea-level, Bad Water, Death Valley, 5; Warm Sulphur Spring, Panamint Mts., 1100 ft., 1; Johnson Canyon, Panamint Mts., 6000 ft., 3; ½ mi. SW Junction Ranch, 16 mi. SSE Darwin, 1; lava beds; near Little Lake, 3; Little Lake, 19; Mountain Springs Canyon, Argus Mts., 5500 ft., 7; 1½ mi. S mouth Mountain Springs Canyon, Argus Mts., 3300 ft., 2; 7 mi. S Little Lake, lava beds, 1. *San Bernardino Co.:* 2 mi. N Horse Spring, Kingston Range, 4000 ft., 1; Beck Spring, Kingston Range, 4500 ft., 2; Horse Spring, Kingston Range, 4700 to 4750 ft., 9; N side Clark Mountain, 5000 to 5300 ft., 11; SE side Clark Mountain, 6300 ft., 5; Mescal Spring, 8½ mi. E Valley Wells, 1; Granite Wells [= 33½ mi. N and 12½ mi. W Barstow], 3950 ft., 2; 3 mi. N Cima, 4500 ft., 1; Cedar Canyon, Providence Mts., 5000 to 5300 ft., 11; 5 mi. NE Granite Well, Providence Mts., 5400 ft., 10; 6 mi. S Granite Well, Providence Mts., 3800 ft.,

15; 3 mi. E Mt. Manchester, 12 mi. N Needles, 3; 1½ mi. NE Barstow, 2; Colton Well, Providence Mts., 3200 ft., 2; Mitchell's Caverns, Providence Mts., 4500 ft., 7; pass between Granite and Providence mts., 4100 ft., 13; 7 mi. NW Essex, 2000 ft., 1; Colorado River, opposite the Needles, 5; Oro Grande, 10; 3 mi. SW Lavic, 1800 ft., 5; 4 mi. S Lavic, 1800 ft., 11; 5 mi. S Lavic, 2; 6 mi. S Lavic, 1; Imperial Mine, 9 mi. S Lavic, 3; Victorville, 19; 3 mi. W Amboy (lava flow), 1; 7½ mi. NE Chubback, Old Woman Mts., 2320 ft., 2; Cottonwood Spring, 10 mi. W Old Woman Springs, 2; Cushenburry Springs, San Bernardino Mts., 2; Horn Mine, E base Turtle Mts., 14 mi. NE Blythe Junction, 4; Sheep Hole Mts., 23 mi. S Amboy, 2300 ft., 2; 4 mi. N Warrens Well, 5; 1 mi. NW Warrens Well, Morongo Valley, 4; mouth 49 Palms Canyon, 4 mi. W Twenty-nine Palms, 1; Quail Springs, 17 mi. E Morongo Valley, 3. *Riverside Co.:* Palm Springs, 452 ft., 3; above Ehrenberg, Colorado River, 1; 3 mi. S Cottonwood Spring, 2400 ft., 2; Dos Palmos Springs, Santa Rosa Mts., 3500 ft., 2; "Indian Rocks," 7½ mi. SE Shaver Summit, 1570 ft., 1. *Imperial Co.:* Beal Well, 1346 ft., 9; 8 mi. S Palo Verde, 1; 12 mi. S Palo Verde, 2; 20 mi. above Picacho, Colorado River, 2; 13 mi. NE Glamis, 3; Potholes, Colorado River, 2; 1 mi. E Mountain Spring, 2000 ft., 1; 3 mi. E Mountain Spring, 1200 ft., 6; 8 mi. SSE by S Coyote Wells, 7; Pilot Knob, Colorado River, 3. **Nevada:** *Mineral Co.:* Marietta, 4900 ft., 2; Huntoon Valley, 5700 ft., 1. *Esmeralda Co.:* 7 mi. N Arlemont, 5500 ft., 1; Cave Spring, 6200 and 6245 ft., 2; Fish Lake, 4800 ft., 5; 2 mi. S Piper Peak, Silver Peak Range, 7500 ft., 6. *Nye Co.:* 7 mi. E Nyala, Quinn Canyon Mts., 7000 ft., 2; 14 to 15 mi. SW Sunnyside, White River Valley, 5800 ft., 3; Big Creek, Quinn Canyon Mts., 5700 to 5800 ft., 13; Old Mill, N end Reveille Valley, 6200 ft., 1; 1 mi. SW Cactus Spring, Cactus Range, 1; 8½ mi. E Cliff Spring, 6200 ft., 2; 2 mi. NW Indian Spring, Belted Range, 6300 to 6500 ft., 5; Indian Spring, Belted Range, 7200 to 7400 ft., 3; ½ mi. S Oak Spring, 5700 ft., 6; 5 mi. W White Rock Spring, Belted Range, 7300 ft., 5; NW base Timber Mtn., 4200 ft., 2; 8½ mi. NE Springdale, 4250 ft., 1; 7 mi. E and 2 mi. N Grapevine Peak, 5100 ft., 3; 5 mi. E and 1 mi. N Grapevine Peak, 5500 ft., 5; 2½ mi. E and 1 mi. S Grapevine Peak, 7000 ft., 7; Amargosa River, 3 to 4 mi. NE Beatty, 3400 to 3500 ft., 2; Ash Meadows, 4½ mi. NW Devils Hole, 2200 ft., 1. *Lincoln Co.:* Eagle Valley, 3½ mi. N Ursine, 5600 to 5900 ft., 3; 2 mi. S Pioche, 6000 ft., 1; 4 mi. NE Crystal Spring, 4300 ft., 4; 1½ mi. NE Crystal Spring, 4100 ft., 2; Meadow Valley Wash, 7 mi. S Caliente, 4500 ft., 6; 16 mi. E Groom Baldy, 4600 ft., 4; Meadow Valley Wash, 5½ mi. N Elgin, 4000 ft., 1; 5½ mi. N Summit Spring, 4700 ft., 1; Meadow Valley Wash, 21 mi. S Caliente, 3200 ft., 2. *Clark Co.:* Valley of Fire, 12 mi. SW Overton, 1; 2½ mi. N Hoover Dam Ferry, 2; 4½ mi. W Boulder City, 2700 ft., 2; north side Potosi Mountain, 5800 ft., 2; 8 mi. S Dead Mtn., 2700 ft., 6; Hiko Spring, 8 mi. SSE Dead Mtn., 1900 ft., 22. **Utah:** *Iron Co.:* Parawan [=Parowan], 2 (U. S. Nat. Mus., Biol. Surv. coll.). *Washington Co.:* St. George, 2850 ft., 19; S side Virgin River, St. George, 7. **Arizona:** *Mohave Co.:* 12 mi. N Wolf Hole, 2 (U. S. Nat. Mus., Biol. Surv. coll.); 10 mi. N Wolf Hole, 3800 ft., 4; 6 mi. N Wolf Hole, 4900 ft., 1; W slope Limekiln Canyon, Virgin Mts., 6000 ft., 4 (U. S. Nat. Mus., Biol. Surv. coll.); 1 mi. W Diamond Butte, 5000 ft., 1 (U. S. Nat. Mus., Biol. Surv. coll.); lower end Toroweap Valley, 4200 ft., 23 (6 in U. S. Nat. Mus., Biol. Surv. coll.); Hoover Dam Ferry, 650 ft., 1; Mud Spring, 12 mi. WSW Chloride, 3440 ft., 2; foot of the Needles, Colorado River, 1. *Yuma Co.:* Black Peak, 5 mi. E Parker, 4; Harquahala Mts., 3400 ft., 1; 10 mi. E Quartzite, 4. **Mexico:** *Lower California:* 6 mi. S, 3½ mi. E Mountain Spring, 2; Las Palmas Canyon, W side Laguna Salada, 200 ft., 12; El Mayor, Hardy River, 30 ft., 1; Los Palmitos, 5 (San Diego Soc. Nat. Hist. coll.); 5 mi. N San Felipe, 3 (San Diego Soc. Nat. Hist. coll.); San Felipe, 8 (7 in San Diego Soc. Nat. Hist. coll.).

Peromyscus crinitus pallidissimus Huey

Peromyscus crinitus pallidissimus Huey, Trans. San Diego Soc. Nat. Hist., vol. 6, p. 389, August 28, 1931.

Type.—Adult male, no. 8864, San Diego Soc. Nat. Hist., skin with skull; unnamed island, Gonzaga Bay, lat. 29° 50′ N, long. 114° 20′ W, Lower California, Mexico; November 21, 1930; collected by A. W. Anthony; original no. 1175. Type not seen by us.

Range.—Restricted to an island in Gonzaga Bay, Gulf of California. See figure 1.

Diagnosis.—Body short; tail long, averaging about 140 per cent of length of head and body; upper parts near (16′c) Pale Ochraceous-Buff, overlain with brownish and dusky; underparts white; dorsal tail stripe dusky; feet white; skull small.

Comparisons.—Differs from *disparilis* in less ochraceous color, upper parts less overlain with dark color, and in most specimens a less hairy tail. Comparison with *stephensi* has been made in the account of that race.

Remarks.—The pale color of this insular race is its distinguishing feature, so far as we can make out from the one adult male and 3 subadult individuals examined. The greatest length of the adult skull, 24.6 mm, exceeds that of any other adult specimen of the species measured from as far north as, and including, the type locality of *stephensi*. Great length of the skull, then, may be an additional distinctive character, but more specimens will be needed to confirm this.

Specimens examined.—Total number, 4 (San Diego Soc. Nat. Hist. coll.), from the type locality.

Peromyscus crinitus disparilis Goldman

Peromyscus crinitus disparilis Goldman, Proc. Biol. Soc. Washington, vol. 45, p. 90, June 21, 1932.

Peromyscus crinitus stephensi, Osgood, North Amer. Fauna, no. 28, p. 233, April 17, 1909, part.

Peromyscus crinitus rupicolus Benson, Proc. Biol. Soc. Washington, vol. 53, p. 2, February 16, 1940. Type from Paso MacDougal, E end Sierra Hornaday, Sonora, Mexico.

Peromyscus crinitus scopulorum Benson, Proc. Biol. Soc. Washington, vol. 53, p. 2, February 16, 1940. Type from Cerro La Cholla, 6 mi. WNW Punta Peñasca, Sonora, Mexico.

Type.—Adult male, no. 202989, U. S. Nat. Mus., Biol. Surv. coll., skin with skull; Tinajas Altas, Gila Mountains, 2000 ft., Yuma County, Arizona; November 22, 1913; collected by E. A. Goldman; original no. 22304. Type not seen by us.

Range.—Southwestern Arizona, south of the Gila River, and northwestern Sonora south to near Punta Peñasca. See figure 1.

Diagnosis.—Body short; tail long, averaging about 147 per cent of length of head and body; upper parts near (16 ″) Light Ochraceous-Buff, overlain with brown and blackish; underparts white; dorsal tail stripe dusky; feet white; skull small.

Comparisons.—Comparisons with adjoining races have been made in accounts of those races.

Remarks.—Topotypes of this race are the palest individuals seen of the species. The relatively long tail parallels the condition obtaining on the opposite side of the Colorado River.

When Benson named *rupicolus* and *scopulorum* he accurately described the color differences between the isolated populations concerned. Also he pointed out some features of the skull that he thought distinguished *scopulorum* from the other nearby populations. The differences were, in *scopulorum*, greater length of skull, nasals, and palatine slits and more rounded braincase, which is higher in the region of the interparietal. In the last mentioned feature there is some overlap. Otherwise we find the differences to be precisely as stated by him for the 6 specimens, only 2 of which we consider as adults. Furthermore, we think that the characters, at least those of color, owe their existence to response, by the mice, through many generations, to the color of the rocks and soils where the isolated populations live. Benson's employment of a formal subspecific name for each isolated variant in this region may be the best, or a good, means of dealing with the variation. *P. c. disparilis* is lightest colored, *rupicolus* is darkest and *scopulorum* is intermediate. In support of the view that formal naming is justified, it can be pointed out, as Benson (Proc. Biol. Soc. Washington, vol. 53, p. 3, 1940) did, that the differences are associated with populations having a high degree of isolation, one from each of the others. Up to this point, the case for separately naming each of the three populations, to us, is clear.

One of the difficulties that we encounter in according subspecific status to each of the

populations is comprised in our effort to be consistent in dealing with variation throughout the range of the entire species. If we applied a subspecific name to each of the other variants of similar nature found within the remainder of the range of the species, names would be so numerous, and based on so slight a foundation (mainly minor variations in color), that the portrayal of geographic variation otherwise than in color would be obscured. Because color varies independently of other features, for example size as comprised in length of tail, length of body, weight of animal, and size of skull, which four things in general parallel one another in variation, the trinary system of nomenclature, for these mice, fails to express adequately the degree and kind of variation in all characters. In the present paper we attempt to portray the total of variation by means of subspecific names. Therefore, where color varies in a fashion suggestive of microgeographic races, we choose to indicate this variation by description rather than by the trinary system of zoological nomenclature.

Specimens examined.—Total number, 53, from the following localities: **Arizona:** *Yuma Co.:* 10 mi. W Wellton, 1 (Mus. Zool., Univ. Mich.); 5 mi. S Wellton, 2 (Mus. Zool., Univ. Mich.); 20 mi. S Wellton, 3 (Mus. Zool., Univ. Mich.); Tinajas Atlas, 1150 to 1660 ft., 19 (1 in coll. R. Ellis); 8½ to 9 mi. E Tinajas Altas, 2 (Mus. Zool., Univ. Mich.); Tule Tank, 1275 to 1350 ft., 13 (1 in Mus. Zool., Univ. Mich.). **Mexico:** *Sonora:* Paso MacDougal, E side Sierra Hornaday, 850 ft., 7; Cerro La Cholla, 6 mi. WNW Punta Peñasca, 50 ft., 6.

Peromyscus crinitus delgadilli Benson

Peromyscus crinitus delgadilli Benson, Proc. Biol. Soc. Washington, vol. 53, p. 1, February 16, 1940.

Type.—Subadult male, no. 83042, Mus. Vert. Zool., skull with skin; 2 mi. S Crater Elegante, Sierra del Pinacate, 34 mi. W Sonoita, Sonora, Mexico; March 28, 1938; collected by Margarito Delgadillo; original no. 4963 of Seth B. Benson.

Range.—Limited to the Pinacate lava field in northwestern Sonora. See figure 1.

Diagnosis.—Body short; tail long, amounting to 134 per cent of length of head and body in three adult males (142 per cent in one adult female); average weight of three adult males, 12.8 grams, adult female, 11.8 grams; upper parts near (16′′′′) Chaetura Drab; underparts showing much plumbeous with wash of near (*e*) Pale Ochraceous-Buff; tail both above and below same color as upper parts of body; feet black except toes, which are white; skull small.

Comparisons.—Differs from black specimens of other races in having the antiplantar face of the foot black all the way to the base of the toes and in that the tail is not bicolored but black all around. There appears to be less reddish color than in any other of the "black" populations of the species. Except in the features just mentioned, *delgadilli*, so far as we can see, agrees with *disparilis*.

Remarks.—In recognizing this population of dark, almost black, colored mice as a separate subspecies, we may fail in consistency of treatment. In the first place, differences in color alone we held in the account of *disparilis* to be insufficient basis for employment of a distinctive subspecific name. In the second place, mice nearly or quite as black as these from Sonora occur at 3 other places within the range of the species and none of these here is accorded subspecific distinction from nearby, lighter-colored populations. In the third place, of the 8 known specimens, 1 is light colored like animals from the Sierra Hornaday nearby, as pointed out by Benson in the original description. One implication of this is that a larger sample (Benson had 8 in all) might show the black animals to be in the minority, although we do not think this will prove to be the case. Thus, it can be argued that we fail in consistency for three reasons and that nearer approach to consistency of treatment by us would be accomplished if we placed the name *delgadilli* as a synonym of *disparilis*, and we have no quarrel with the person who does so. As indicated in the account of *disparilis*, the trinary system of nomenclature is so inelastic as here not to express adequately the variation found.

On the other side of the case, it can be pointed out that *P. c. delgadilli* is recognized because the extent (not intensity) of black is greater than in any of the other populations.

For example, the black color extends over the antiplantar faces of the hind feet to the base of the toes, and the under side of the tail is black. In the three other black-colored populations, the feet and under side of the tail are distinctly whitish. Also, the hind foot may be significantly longer than in any adjacent population. Indication of this is provided by the greater average length of the hind feet in the 8 specimens of *delgadilli* and by the fact that the minimum measurement of the feet of adults is greater than the minimum in other adjacent populations. Of course, a larger sample will be required to show whether or not there is a significant difference in length of hind foot between *delgadilli* and *disparilis*.

Specimens examined.—Total number, 8, all from Sonora, Mexico, as follows: Crater Elegante, 34 mi. W Sonoita, 1100 ft., 4; 2 mi. S Crater Elegante, 34 mi. westward from Sonoita, 3; Rio Sonoita, 30 mi. WSW Sonoita, 1.

Peromyscus crinitus auripectus (Allen)

Sitomys auripectus Allen, Bull. Amer. Mus. Nat. Hist., vol. 5, p. 75, April 28, 1893.
Peromyscus crinitus auripectus, Osgood, North Amer. Fauna, no. 28, p. 231, April 17, 1909.
Peromyscus crinitus peridoneus Goldman, Jour. Mamm., vol. 18, p. 92, February 14, 1937.

Type from Bright Angel Trail, 4800 ft., S side Grand Canyon, Coconino County, Arizona.

Type.—Adult female, no. 5117/3997, Amer. Mus. Nat. Hist., skin with skull; Bluff City, San Juan County, Utah; May 14, 1892; collected by C. P. Rowley. Type not seen by us.

Range.—Southern Wyoming, eastern and southern Utah, western Colorado, northwestern New Mexico, and northeastern Arizona west to Supai. See figure 1.

Diagnosis.—Body long; tail short, averaging about 110 per cent of length of head and body; hind foot long; weight unrecorded; upper parts near (*c*) Ochraceous-Buff; underparts white, often with pectoral spot of same buff color as upper parts; dorsal tail stripe same color as upper parts of body except with more blackish; feet white; skull large; shelf of bony palate relatively short.

Comparisons.—Comparisons with adjoining races have been made in the accounts of those forms.

Remarks.—Available specimens indicate that the range of this race is separated from that of *pergracilis* by the Uinta and Wasatch mountains of Utah. The range of *auripectus* meets only the range of *stephensi*. There, complete intergradation occurs. The name *Peromyscus crinitus peridoneus* Goldman was based on one of these intergrades. Specimens from Pipe Creek and nearby Phantom Ranch are clearly referable to *auripectus* rather than *stephensi*. They are intermediate in relative length of tail, in color and in size of skull, but in each character they are nearer *auripectus*. Specimens from Toroweap Valley, Arizona, and the territory from as far north of it as St. George, Utah, also are intermediate. The total length is about as in *stephensi*, the relative length of tail is intermediate but more as in *auripectus*, the color is less reddish and more as in *stephensi* and the skull is small as in *stephensi* to which race these specimens are here referred. Specimens from Black Tank in the lava beds at 6100 ft., of Coconino County, Arizona, average darker than other specimens of *auripectus* and may reflect the influence of the dark-colored rocks on which the animals are said to have been trapped. Except for this one population and excepting also the animals along the western border of the range of the subspecies where intergradation occurs with *stephensi*, *auripectus* is relatively uniform in characters. The large size of animal and skull, relatively short tail, and bright ochraceous coloration are characters maintained in full measure from northeastern Arizona north to southern Wyoming. These northernmost specimens from Sweetwater County, Wyoming, and Daggett County, Utah, in other characters, too, agree closely with topotypes of *auripectus*, differing, so far as we can see, only in that the palatine slits and maxillary toothrow are, on the average, slightly shorter.

Specimens examined.—Total number, 140, from the following localities: **Wyoming:** *Sweetwater Co.:* 1 mi. N Linwood (Utah), 1 (Mus. Zool., Univ. Mich.). **Utah:** *Kane Co.:*

Kanab, 5200 ft., 5. *Daggett Co.:* Sheep Creek, 7 mi. S Manila, 7 (Mus. Zool., Univ. Mich.). *Sevier Co.:* E of Summit, 1. *Emery Co.:* 21 mi. out of San Rafael, 2. *Wayne Co.:* Canesville [=Caineville], 1 (U. S. Nat. Mus., Biol. Surv. coll.). *San Juan Co.:* Edwin, Natural Bridge, 5725 ft., 2; Cottonwood Wash, 8 mi. N Bluff, 4700 ft., 1; Bluff, 4400 ft., 16; Aneth, 4650 ft., 2; Lime Wash, 5 mi. NE Mexican Hat, 4500 ft., 1; Rainbow Bridge, 4; Navajo Mtn. Trading Post, 5 mi. SE Navajo Mtn., 1. **Colorado:** *Garfield Co.:* 12 mi. above Glenwood Springs, 6000 ft., 1 (coll. E. R. Warren); 8 mi. W Rifle, 1; Atchee, 6600 ft., 1 (coll. E. R. Warren). *Mesa Co.:* Grand Junction, 5 (4 in coll. E. R. Warren); Mack, 4540 ft., 1 (coll. E. R. Warren). *Montrose Co.:* Bedrock, 5150 ft., 3 (coll. E. R. Warren); Coventry, 6800 ft., 1 (coll. E. R. Warren). *San Miguel Co.:* near Coventry, 6800 ft., 1 (coll. E. R. Warren). *Montezuma Co.:* Ashbaugh's Ranch, T. 36 N, R. 18W, N. M. P. M., 5350 ft., 4 (coll. E. R. Warren). **Arizona:** *Coconino Co.:* 2 mi. W Lees Ferry, 3250 ft., 3; 6 mi. W Grand Canyon Bridge, Marble Canyon, 11; ½ mi. W Navajo Spring, Echo Cliffs, 3; Supai Canyon, 1 (U. S. Nat. Mus., Biol. Surv. coll.); Phantom Ranch, 12 (U. S. Nat. Mus., Biol. Surv. coll.); Pipe Creek, Grand Canyon, 1 (U. S. Nat. Mus., Biol. Surv. coll.); Yavapai Point Trail, Grand Canyon, 1 (U. S. Nat. Mus., Biol. Surv. coll.); Moa Ave, 7; Cameron, 4200 ft., 3; E bank Little Colorado River, ½ mi. SE Cameron, 4000 ft., 2; Tanner Tank, 3; Black Tank lava beds, 6100 ft., 9; 12 mi. N Deadman Flat, NE San Francisco Mtn., 2. *Navajo Co.:* Right fork Segi-of-Sosie, 11 mi. NW Kayenta, 4; Skeleton Mesa, 16 mi. WNW Kayenta, 1; Bat Woman Canyon, 16 mi. W Kayenta, 1; Segi Canyon, 13 mi. WSW Kayenta 6500 ft., 4; Oraibi, 6000 ft., 5; Keams Canyon, 6200 ft., 3. **New Mexico:** *San Juan Co.:* Chaco Canyon National Monument, 6400 ft., 2. Osgood (North Amer. Fauna, no. 28, p. 232, 1909) has recorded specimens from Mesa Verde, Colorado, and Holbrook, Arizona, and these localities were taken into account in preparing the distribution map, fig. 1.

Museum of Vertebrate Zoology, Berkeley, California.

SKELETAL VARIATIONS IN GUINEA PIGS AND THEIR INHERITANCE

By Herluf H. Strandskov

Evidence that variations occur in the skeletal elements of vertebrates and that heredity plays a role in the production of such variations has been presented over a period of years. Carlisle as early as 1814 noted extra skeletal parts in the hands and feet of man and showed that these variations have a hereditary basis. Auld (1889) gave an account of the inheritance of toe variations in hogs and horses.

Castle et al. (1909) were the first to consider the more general questions, that is, to consider the extent to which all or most of the different bones of the body are affected by genetic factors, and in addition, to determine the relative rôles of general body size factors and of factors acting locally. They attacked the problem by crossing two strains of rabbits which differed in body size, and by comparing the skeletal dimensions of the F_1 with those of each of the two parental strains. They found that the dimensions of the bones of the F_1 were midway between those of the two parental lines. They came to the general conclusion that skeletal dimensions and consequently body size and proportion are determined almost exclusively by general body size factors. In later papers Castle (1914, 1922, 1923, 1924, 1929) has continued to support this general

point of view. Davenport (1917) estimated that less than half of human stature is controlled by general growth factors. The rest he maintains is the composite result of special factors acting locally. Sumner (1923, 1924) measured the skull, femur, and foot lengths of several geographic races of field mice. He found that the dimensional relationships of these parts differ in different races. He concludes that every part of the body may be affected by general body size factors, but that each part may also be affected by genes which are specific for the particular part in question. Gates (1926) compared the skeleton of the Japanese Waltzing mouse, *Mus wagneri*, and the wild mouse. He found differences in the position of the internal nares, the size of the foramen magnum, and the number of tail vertebrae. He also came to the general conclusion that specific factors operate on individual parts. Green (1931) compared certain of the skeletal elements of *Mus musculus*, *Mus bactrianus*, F_1, and backcross animals. He found that *Mus musculus* has a greater cranial, humeral, femoral, and tibial lengths than *Mus bactrianus*, and also that it has more caudal vertebrae. The F_1 he found, in general, to be intermediate between the two parental strains. He found, however, some differences in the behavior of the different skeletal elements in the crosses and concludes that most but not all genes for body size are of a general type. Wright (1932) analyzed the data of Castle (1914) and of Dunn (1928) for general group and special size factors. He concludes that in this material, "the influence of general size factors preponderates, but the residuals indicate the existence of group factors for the fore limbs and hind limbs collectively, for the hind limbs separately and for the wings in fowls, the only case in which two fore limb measurements were available. Special factors acting on each part separately from the others are also indicated." Eaton (1939) compared the weights and lengths of several of the long bones of three inbred and one non-inbred line of guinea pigs. His results show some differences between the skeletal elements of the different inbred lines which suggest specific factors operating on them but he did not draw any general conclusions regarding the rôles of general and specific factors.

The present study is a comparison between 16 skeletal measurements of twenty males and twenty females of each of two highly inbred strains of guinea pigs. The object of the comparison was, in general, to obtain additional information on inherited skeletal variations in vertebrates and to contribute to a knowledge of the relative rôles of general and specific genetic factors in affecting skeletal dimensions and consequently in affecting body size and proportion. The reasoning in back of the supposition that such a comparison might throw some light on the question stated was as follows. The stock from which the two lines was started was a genetically variable one. Therefore, it was reasoned that if general size factors and local factors affect skeletal dimensions this original stock might reasonably be expected to have possessed a number of variations in such factors. Furthermore, it was reasoned that if genetic variations existed in the original stock, the two lines might reasonably be expected to have possessed different sets of variable genetic factors, because no conscious selection was practiced in establishing the lines. Furthermore, it was reasoned that the inbreeding of the two lines should have given genetic uniformity within

the lines so that if bone length differences existed, even though small, they could be detected by appropriate statistical methods.

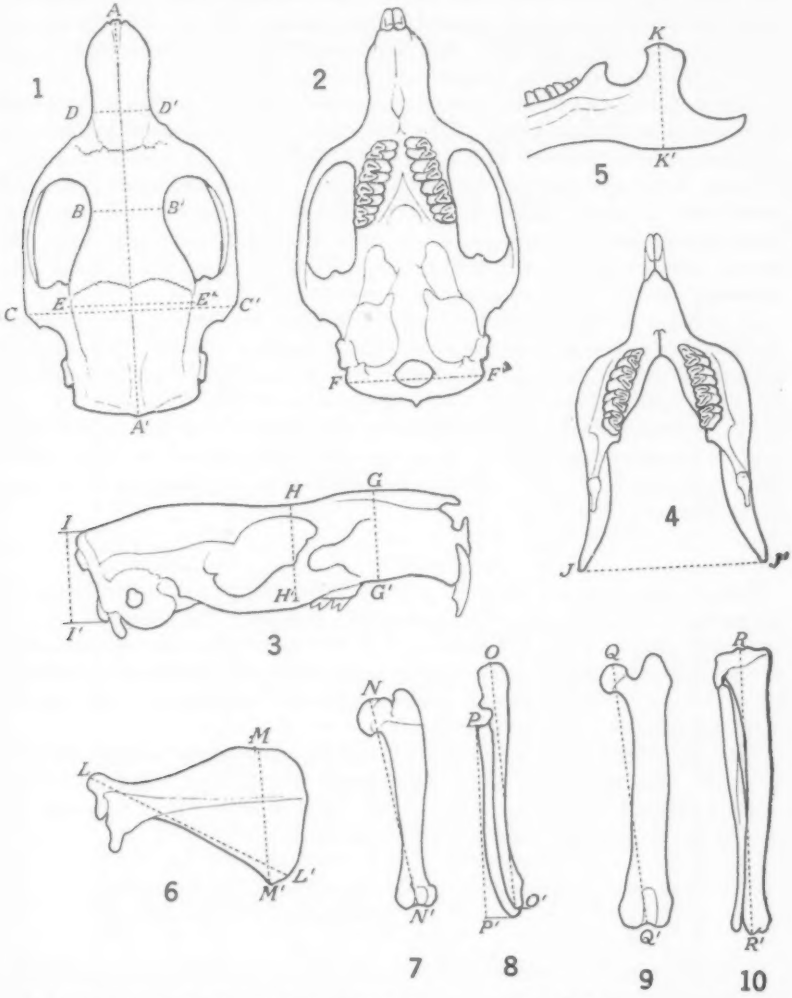

FIG. 1. Drawings showing the bones which were measured and where the measurements were taken.

The two inbred lines (Family 2 and Family 13) are two of the several lines of brother-sister matings that were started at the United States Bureau of Animal Industry in 1906. The particular branches compared are those that were brought to the University of Chicago by Professor Sewall Wright in 1925.

At the time the present study was started each of the two branches had at least twenty-four generations of brother-sister matings in back of it. Thus each may be considered highly inbred. According to Wright (1931) heterozygosity, under the system of mating followed, should decrease 19.1 per cent per generation. Theoretically, therefore, each line should have been more than 99 per cent homozygous when the present study was started.

The bones measured were carefully removed from the bodies immediately after the animals were killed. They were then partially cleaned and allowed to dry for several months. Finally they were boiled for a few minutes in a weak solution of lye and scraped clean with a knife. The measurements were all taken with a finely calibrated caliper. Each measurement was taken three times and averaged. There was never more than an insignificantly small difference between the three measurements. (Figure 1 shows which bones were measured and where the measurements were taken.)

In addition to the bone measurements indicated, the live body weights and the total body lengths were recorded. The latter was obtained by stretching the animal out on its back immediately after it was killed and by measuring the distance from the tip of its nose to the base of its tail.

The sacrificed animals were considerably more than a year old. Hence they may be considered as adults. They were the same animals as those whose liver, lung, heart, thyroid, adrenal and spleen were compared in a previous paper (Strandskov, 1939).

RESULTS

Table I gives the mean (M), the standard deviation (σ) and the coefficient of variability (C. V.) of each of the measurements taken. The means in the columns that combine males and females (♂ ♀) are the means of the measurements of forty animals, whereas, those of the males or females considered separately (♂ or ♀) are of twenty animals. The weights are recorded in grams and the linear measurements in centimeters.

Table II gives the probabilities that the compared means are significantly different. The significance of the difference of each pair was obtained by calculating the statistic (t) according to the formula given below and then by looking up (t) in tables of the probability integral.

$$t = \frac{\Delta}{\sqrt{\frac{\Sigma(X_1^2 - (\Sigma X_1)^2/N_1) + \Sigma(X_2^2 - (\Sigma X_2)^2/N_2}{N_1 + N_2 - 2} \frac{1}{N_1} + \frac{1}{N_2}}}$$

In the formula, X equals the weight or the linear measurement, Δ equals the difference between the means, and N equals the number of individuals involved. (For a discussion of the formula used see Fisher, 1928.) A probability of 0.05 or less is considered significant, that is, it is interpreted to mean that the compared means are significantly different. For instance in the first column of Table II the difference between the means of the body weights of Family 13 ♂ ♀ (males and females combined) and of Family 2 ♂ ♀ (males and females

TABLE 1.—*Table showing the mean (M), the standard deviation (σ), and the coefficient of variability (CV) of the body weight, the body length and the linear measurements of the bones of two inbred strains of guinea pigs (Family 2 and Family 13)*

	13♂♀			2♂♀			13♂			13♀			2♂			2♀		
	$\overline{V}$	σ	CV	$\overline{V}$	σ	CV	$\overline{V}$	σ	CV	$\overline{V}$	σ	CV	$\overline{V}$	σ	CV	$\overline{V}$	σ	CV
Body weight	*992.2	99.32	10.0	793.1	68.93	8.6	1044.5	68.61	6.5	939.8	98.98	10.5	802.2	65.58	8.1	777.9	69.02	8.8
Body length	31.36	.65	2.0	29.74	.63	2.1	31.76	.49	1.5	30.97	.61	1.9	29.99	.62	2.0	29.48	.54	1.8
Cranial length	6.66	.22	3.2	6.68	.20	3.0	6.84	.15	2.1	6.48	.09	1.3	6.85	.13	1.8	6.51	.09	1.3
Frontal width	1.28	.08	6.5	1.29	.10	7.5	1.35	.04	2.9	1.21	.04	3.2	1.38	.03	2.3	1.20	.04	3.3
Zygomatic width	3.81	.09	2.3	3.71	.12	3.3	3.88	.06	1.5	3.75	.06	1.6	3.81	.09	2.3	3.61	.06	1.6
Nasal width	1.24	.08	6.8	1.22	.09	7.4	1.32	.04	3.0	1.17	.03	2.7	1.30	.05	3.9	1.14	.04	3.4
Temporal width	1.67	.05	2.7	1.57	.04	2.2	1.70	.03	1.9	1.65	.05	2.7	1.58	.03	2.0	1.56	.04	2.5
Occipital width	2.34	.06	2.3	2.34	.08	3.3	2.38	.03	1.3	2.30	.05	1.9	2.39	.09	3.6	2.30	.06	2.6
Nasal depth	1.49	.07	4.8	1.48	.10	6.5	1.55	.03	2.0	1.42	.03	2.2	1.57	.05	3.2	1.39	.02	1.6
Palatal depth	1.64	.05	2.7	1.68	.05	3.0	1.66	.04	2.3	1.63	.05	2.8	1.71	.05	2.6	1.65	.03	1.9
Occipital depth	1.59	.08	4.7	1.58	.07	4.1	1.66	.04	2.3	1.53	.03	2.1	1.62	.05	2.8	1.53	.05	2.9
Scapular length	3.39	.09	2.6	3.29	.07	2.2	3.40	.12	3.3	3.37	.05	1.5	3.30	.07	1.9	3.27	.08	2.3
Scapular width	2.50	.11	4.4	2.31	.08	3.6	2.54	.13	5.1	2.47	.08	3.0	2.34	.07	3.1	2.27	.08	3.5
Humeral length	3.77	.07	1.9	3.85	.08	2.1	3.77	.08	2.0	3.77	.07	1.8	3.85	.09	2.3	3.84	.08	2.0
Ulnar length	4.44	.09	2.0	4.27	.11	2.4	4.51	.07	1.6	4.38	.05	1.1	4.32	.11	2.4	4.22	.08	1.8
Radial length	3.48	.07	2.0	3.33	.08	2.4	3.52	.07	1.8	3.44	.05	1.4	3.37	.08	2.2	3.29	.07	1.9
Femoral length	4.50	.07	1.5	4.54	.10	2.2	4.53	.06	1.3	4.46	.07	1.4	4.56	.11	2.3	4.53	.10	2.2
Tibial length	4.87	.09	1.8	4.96	.10	1.9	4.91	.09	1.7	4.82	.07	1.3	4.99	.09	1.7	4.92	.10	1.9
N =	40			40			20			20			20			20		

* The weight of the body is in grams; the linear measurements are in centimeters.

combined), shows a probability of 0.000. Consequently, Family 13 is considered as having a significantly greater body weight than Family 2. On the other hand the probability of the difference of the means of skull length is only 0.569, consequently the skull lengths of the two families are not considered significantly different.

It will be noted that an asterisk appears in Table II before some of the values of t and is absent before others. If no asterisk appears the mean of the measurement of the first group in the heading of the vertical column is larger than that of the second. If an asterisk appears the reverse is true. For instance

TABLE 2.—*Table showing the probabilities (P) that the means of the body weight, body length and skeletal measurements of two highly inbred strains of guinea pigs (Family 2 and Family 13) are different*

	13♂♀-2♂♀		13♂-2♂		13♀-2♀		13♂-13♀		2♂-2♀	
	t	P	t	P	t	P	t	P	t	P
Body weight	10.45	.000	11.13	.000	6.00	.000	3.89	.000	1.42	.156
Body length	11.36	.000	9.94	.000	8.19	.000	4.49	.000	2.76	.006
Cranial length	*.57	.569	*.37	.711	*1.36	.174	9.40	.000	9.99	.000
Frontal width	*.59	.555	*2.62	.009	.40	.680	11.46	.000	15.61	.000
Zygomatic width	4.41	.000	3.12	.002	*2.92	.004	6.83	.000	8.48	.000
Nasal width	1.36	.174	1.52	.129	2.18	.029	12.99	.000	10.82	.000
Temporal width	11.72	.000	11.70	.000	6.85	.000	3.42	.001	1.39	.165
Occipital width	0.00	1.00	*.15	.881	.24	.810	6.45	.000	3.74	.000
Nasal depth	.53	.596	*.96	.337	3.71	.000	12.67	.000	14.01	.000
Palatal depth	*3.07	.002	*3.32	.001	*1.67	.095	2.73	.006	4.86	.000
Occipital depth	.95	.342	2.65	.008	*.56	.575	11.68	.000	6.27	.000
Scapular length	5.48	.000	3.36	.001	4.87	.000	1.17	.242	1.52	.129
Scapular width	8.98	.000	6.02	.000	7.89	.000	2.14	.032	2.74	.006
Humeral length	*4.32	.000	*2.98	.003	*3.06	.002	0.00	1.00	.22	.826
Ulnar length	7.85	.000	6.41	.000	7.80	.000	6.29	.000	3.52	.000
Radial length	8.75	.000	6.57	.000	7.93	.000	4.13	.000	3.35	.001
Femoral length	*2.31	.021	*1.11	.267	*2.28	.023	3.47	.001	1.13	.258
Tibial length	*4.30	.000	*2.87	.004	*3.86	.000	3.74	.000	2.31	.021

* When no asterisk appears the mean of the first group in the heading of the vertical column is the larger. When an asterisk appears the reverse is true.

the mean of the body weight of Family 13 ♂♀ is greater than that of Family 2 ♂♀, therefore no asterisk appears. On the contrary, the mean of the humerus length of Family 2 ♂♀ is greater than that of Family 13 ♂♀, therefore an asterisk is to be found before the "t" value.

DISCUSSION

An inspection of Table II will show that the two inbred families, Family 2 and Family 13, are significantly different in a number of measurements. This is true for body weight, body length, zygomatic width, temporal width, palatal depth, scapular length, scapular width, humeral length, femoral length and tibial length. This is not true for the six other measurements.

The question that immediately presents itself is this: What are the causes of the observed significant differences? Are they due to differences in the environment or to differences in genetic factors? This question must be answered first, because upon its answer depends further discussion.

From the very start of the present study the two inbred families were maintained under as nearly identical environmental conditions as is possible in an animal colony. They were given the same food, the same pen space, and the same general care. The pens in which they were kept alternated with one another and the attendant did not know which pens contained Family 2 and which contained Family 13 animals. All other precautions were taken to prevent environmental factors from operating differentially. On the other hand, as was stated earlier in the paper, the original stock from which the two families were started, was a genetically heterogeneous one. Hence, since the two families were chosen at random from the original stock and not interbred since then, they might reasonably be expected to be different in some of the genetic factors in which the original stock varied. Taken collectively, therefore, the facts seem to favor the view that the observed differences are due to hereditary rather than to environmental factors. This conclusion is substantiated by the fact that the coefficient of variability for every character within each inbred family is low, whereas, each is high if measurements for both families are combined. Furthermore, comparisons of samples chosen at random from within a family do not give significant differences for any of the characters in question. If environmental factors had produced significant differences within the colony there is no reason why they should not also have produced such differences within a family. Thus the only acceptable conclusion seems to be that the observed significant differences are due to genetic factors and not to environmental differences.

Having accepted this conclusion, it becomes of interest to analyse the nature of the effects of these genetic factors. As shown in Table II Family 13 has a significantly greater body weight than Family 2. This difference has been reported previously by Wright (1922) and by Wright and Eaton (1929). Family 13 also has a greater total body length. However, when the total body length is separated into cranial length and spinal length an interesting relationship comes to light. The cranial length of Family 13 is not significantly greater than that of Family 2. In fact the mean is actually smaller, although not significantly so. The greater total body length of Family 13 is, therefore, due entirely to a greater spinal length. The skull of Family 13 is also no larger than that of Family 2 in nasal width, nasal depth, frontal width, palatal depth, and occipital width. In zygomatic width and temporal width, however, it is significantly greater. In other words the family that has the greater body weight and total body length has a proportionately smaller skull.

Let us now attempt to give a genetic explanation for the differences between the two families in body weight, in spinal length and in the proportion of cranial dimensions to spinal length. The data suggest several hypotheses. One is that the two families differ in specific genetic factors that affect spinal length

and consequently body weight, but which do not affect cranial dimensions. Another is that the two families differ in one or more general growth factors that are responsible, in part at least, for the differences observed between the two families in body weight, spinal length, zygomatic width, and temporal width, but that the two families differ, in addition, in specific factors that affect some cranial dimensions. The latter hypothesis seems the more probable and will be accepted tentatively.

With respect to the length of the bones of the appendages the two families also show some interesting differences. The scapula, ulna, and radius of Family 13 are significantly longer than those of Family 2. This is in agreement with its greater body weight and body length. The humerus is an exception. It is significantly longer in Family 2, the smaller family. As a result of this greater dimension of one part of the fore limb in one family and of another part in the other, the two families have fore legs that are about equal in length. Eaton (1939) found the same relationships in the Washington branches of Families 2 and 13. The bone lengths of the hind limbs of the two families do not correspond with body weight and spinal length. The femur and tibia of Family 2, the smaller family, are significantly longer than those of Family 13. Thus the family with the relatively small body has relatively long hind legs and the family with the relatively large body has relatively short hind legs. Although Eaton (1939) compared the femur and tibia of the Washington branches of the two families, he did not find them significantly longer in Family 2 than in Family 13.

The above mentioned differences in the proportions of the parts of the limbs and differences in the proportions of the size of the limbs to the size of the rest of the body suggest specific genetic factors operating on these parts. It would be difficult to imagine general growth factors that would cause three bones of the forelimb to be longer in one family than in the other and one bone in the same limb to be shorter. Likewise, it would be difficult to imagine general growth factors that would cause one family to have a relatively large body with relatively short hind limbs and another to have a relatively small body with relatively long hind limbs. Whether the specific factor or factors for the fore and hind limbs are the same the data do not reveal, but it seems improbable that they are. If they were, then it would seem that they would also cause the ulna and radius of Family 2 to be longer than those of Family 13, but they are not.

In summary, the most logical genetic explanations for the differences observed between Family 2 and Family 13 appear to be: (1) that the two families differ in one or more general growth factors that are responsible, in part at least, for the greater body weight, spinal length, zygomatic width, temporal width, scapular length, scapular width, ulnar length and radial length of Family 13; and (2) that the two families differ in one or more local factors that cause Family 13 to have a proportionately smaller skull, a shorter humerus, a shorter femur, and a shorter tibia than Family 2.

Sex differences within a family were also found. In most vertebrate species

the males are larger than the females. This, in general, is also true for guinea pigs. Table II shows that the males of Family 13 have a significantly greater body weight and body length than the females of the same family. The same is true for Family 2 with respect to body length. With respect to body weight, however, Family 2 males are not significantly heavier than the females of that family. It is of interest that the same relationship for the Washington branches of the two families was found by Eaton (1938). Apparently there is an inherited difference between the two families in this respect. In other words, in Family 13 there appear to be genetic factors that give a significant sex difference in body weight, whereas in Family 2 such factors are lacking or at least not so potent.

Most of the bones of the males of each of the two families are significantly longer than those of the females of the same family. One notable exception is the scapula. It is not significantly larger in the males of either family.

The cause of the differences between the sexes in body size and more specifically in skeletal dimensions has never been satisfactorily accounted for. One explanation is, of course, that the differences are caused by secondary effects of sex determining genes operating through the secretions of the gonads. While this is a plausible explanation and probably correct to some extent, the argument is not supported by many facts. Moore (1922) found slightly shorter long bones in castrated guinea pigs than in normal animals but his evidence is neither extensive nor conclusive. It is true that Hutt (1929) found the bones of the Leghorn fowl castrates to be longer than those of normal males. Landauer (1937), however, did not get significant differences as a result of the castration of fowl. Thus there does not seem to be general agreement regarding the effects of the secretions of the gonads on bone length. At least, it has not been shown conclusively that bone size differences between sexes are due entirely to secondary effects of sex determining genes.

Other possible hypotheses are of course, (1) that sex determining genes act directly on the bones rather than through the secretions of the gonads, and (2) that genes, other than sex determining genes, are associated with the sex chromosomes and effect bone size directly. The present data do not give any clues as to the most probable hypothesis, but they do suggest that closely inbred strains of guinea pigs would be favorable materials for such a study.

SUMMARY

1. Two closely inbred strains of guinea pigs, Family 2 and Family 13, are compared with respect to body weight, body length, and sixteen skeletal measurements.

2. The two inbred families are shown to be significantly different in body weight, body length, and in ten of sixteen skeletal measurements.

3. The significant differences are attributed to hereditary factors. Of these it would appear that some are general growth factors and that some are specific factors that act on local parts. Especially affected by local factors are some of the cranial bones, the humerus, the femur, and the tibia.

4. The males within each family are shown to be larger than the females in body length and in most of the measured skeletal elements. Suggestions are offered regarding the cause or causes of these sex differences. No final conclusions are drawn, however.

LITERATURE CITED

AULD, R. C. 1889. Some cases of solid-hoofed hogs and two-toed horses. Amer. Nat., vol. 23, pp. 447–449.

CARLISLE, ANTHONY. 1814. An account of a family having hands and feet with supernumerary fingers and toes. Phil. Trans., vol. 104, pp. 94–101.

CASTLE, W. E. 1914. The nature of size factors as indicated by a study of correlation. Pub. Carnegie Inst., vol. 196, pp. 51–55.

——— 1922. Genetic studies of rabbits and rats. Pub. Carnegie Inst., vol. 320, pp. 1–55.

——— 1923. Does the inheritance of differences in general size depend upon general or special size factors? Proc. Nat. Acad. Sci. Wash., vol. 10, pp. 15–22.

——— 1925a. Are the various parts of the body genetically independent in size. Proc. Nat. Acad. Sci. Wash., vol. 10, pp. 181–182.

——— 1924b. Consequences of race crossing. Jour. Hered., vol. 15, pp. 363–369.

——— 1929. A further study of size inheritance with special reference to the existence of genes for size characters. Jour. Exp. Zool., vol. 53, pp. 421–454.

CASTLE, W. E., WALTER, H. E., MULLINEX, R. G., and COBB, S. 1909. Studies of inheritance in rabbits. Carn. Inst. Wash. Publ., no. 114.

DUNN, L. C. 1928. The effects of inbreeding on the bones of the fowl. Storrs Agric. Exp. Sta. Bull., no. 152.

EATON, O. N. 1938. Weights and measurements of the parts and organs of mature inbred and crossbred guinea pigs. Amer. Jour. Anat., vol. 63, pp. 273–295.

——— 1939. A comparative analysis of the measurements of the limb bones of inbred families of guinea pigs and their hybrids as affected by family, sex and age. Amer. Jour. Anat., vol. 64, pp. 485–499.

FISHER, R. A. 1938. Statistical methods for research workers. Edinburgh and London: Oliver and Boyd.

GATES, W. H. 1926. The Japanese waltzing mouse. Carn. Inst. Wash. Publ., vol. 337, pp. 83–138.

GREEN, C. V. 1931. Size inheritance and growth in a mouse species cross (Mus musculus x Mus bactrianus). III. Inheritance of adult quantitative characters. Jour. Exp. Zool., vol. 59, pp. 213–245.

HUTT, Q. G. 1929. Sex dimorphism and variability in the appendicular skeleton of the Leghorn fowl. Poultry Sci., vol. 8, pp. 202–218.

LANDAUER, W. 1937. Studies on Creeper Fowl. XI. Castration and length of bones of the appendicular skeleton in normal and creeper fowl. Anat. Rec., vol. 69, pp. 247–253.

MOORE, C. R. 1922. On the physiological properties of the gonads as controllers of somatic and psychical characteristics. V. The effects of gonadectomy in guinea pigs on growth, bone lengths and weight of organs of internal secretion. Biol. Bull., vol. 43, pp. 285–312.

STRANDSKOV, H. H. 1939. Inheritance of internal organ differences in guinea pigs. Genetics, vol. 24, pp. 722–727.

SUMNER, F. B. 1923. Size factors and size inheritance. Proc. Nat. Acad. Sci. (U. S. A.), vol. 9, pp. 391–397.

——— 1923. Size factors and size inheritance. Proc. Nat. Acad. Sci. Wash., vol. 9, pp. 391–397.

——— 1924. The partial genetical independence in size of the various parts of the body. Proc. Nat. Acad. Sci., vol. 10, pp. 178–180.

WRIGHT, S. 1918. On the nature of size factors. Genetics, vol. 3, pp. 367–374.
——— 1922. The effects of inbreeding and crossbreeding on guinea pigs. III. Crosses between highly inbred families. U. S. Dept. Agric. Bull., no. 1121.
——— 1932. General group and special size factors. Genetics, vol. 17, pp. 603–619.
WRIGHT, S. and EATON, O. N. 1929. Persistence of differentiation among inbred families of guinea pigs. U. S. Dept. Agri. Tech. Bull., no. 103.

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NOTES ON MAMMALS OF NORTHEASTERN NEW MEXICO

BY JOHN ERIC HILL

In July 1938 the American Museum of Natural History, through the generosity of two of its supporters, sent a mammalogical expedition to northeastern New Mexico, near Cimarron, Colfax County. Here the cooperation of Mr. Waite Phillips, owner of the Philmont Ranch, enabled the expedition during two months to make a survey of the mammalian fauna of the southern Sangre de Cristo Range, and adjacent high plains. In the winter and early spring of 1895, C. M. Barber collected in the area herein discussed. His records, published in descriptions of new forms of mammals by Allen (1898, Bull. Amer. Mus. Nat. Hist., vol. 10, p. 291) and Merriam (1904, Proc. Biol. Soc. Wash., vol. 17, p. 130) and in Bailey's "Mammals of New Mexico" (N. Amer. Fauna, no. 53), are primarily of conspicuous mammals, secured by shooting. In 1903, A. H. Howell collected in the Raton Mountains to the north and east, and the high Taos Mountains and the Moreno Valley, to the west of our area, were investigated by several parties of the Biological Survey. The Cimarron Mountains have not been intensively studied, however, and several interesting distributional facts were discovered that make publication of an annotated list seem desirable.

The mountains here (approximately 36° 30′ North, 105° West) are a southeastern extension of the Rockies. They rise from high plains, altitude about 6,500 feet (1,975 meters), frequently with an intermediate mesa, or shelf, several miles in breadth at about 8,500 feet, and reach the highest point at about 12,000 feet (3,600 meters). This highest point on the ranch is called Clear Creek Mountain by local surveyors, but appears on the topographic map as Black Mountain. The top of Clear Creek Mountain is approximately timber line, but no pure Alpine associations were found there. North of the ranch are two peaks above timber line, Baldy Peak and Costilla Peak, but they were not visited.

From timberline to approximately 9,000 feet the flora is predominantly subalpine. Foxtail pine (*Pinus aristata*), limber pine (*P. flexilis*), blue spruce (*Picea pungens*), Engelmann spruce (*P. Engelmanni*), Douglas fir (*Pseudotsuga*), alpine and white fir (*Abies*), quaking aspen (*Populus tremuloides*), bearberry (*Arctostaphylos*), and mountain snowberry (*Symphoricarpus*) were found characteristically.

Between 9,000 feet and 10,500 feet mountain meadows with boggy areas and small streams occur. Here several species of willow, iris, daisy, wild geranium, lupine, locoweed, milk vetch, gentian, and horse mint are characteristic plants. In seepage places near the edges of aspen thickets are stands of tall hellebore

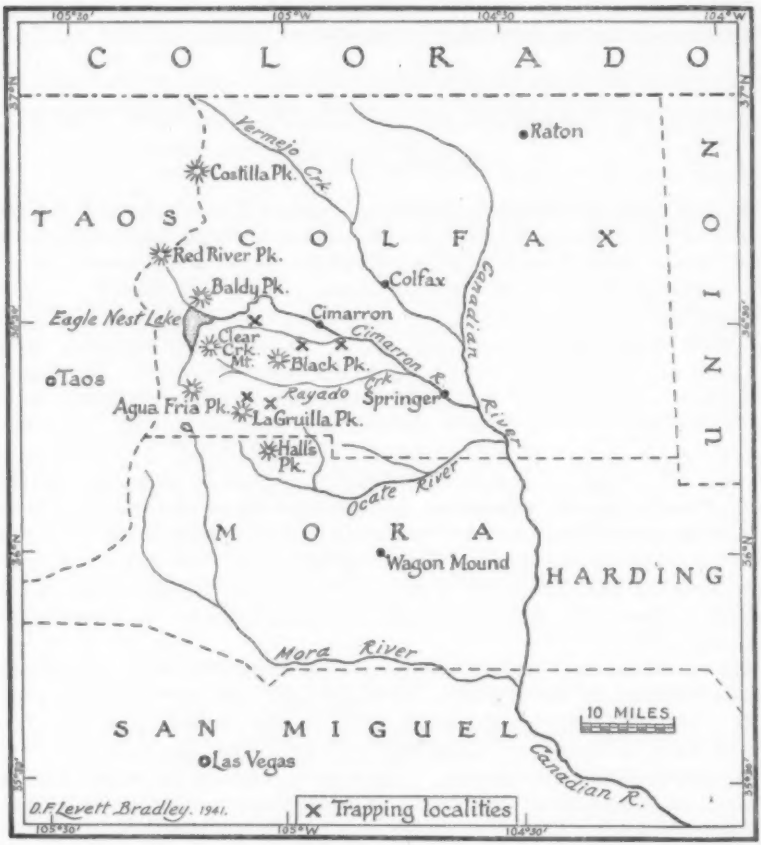

FIG. 1. Map of Colfax County, New Mexico, showing trapping localities mentioned in this report.

(*Veratium*) and scattered shooting stars (*Dodecatheon*) in high grass. In similar, but more sheltered and drier, situations a Mariposa lily (*Calochortus Nuttallii*) occurs.

From 7,000 to about 9,000 feet yellow pine (*Pinus ponderosa*) is characteristic.

In places this species extends higher, as do other plants of this zone. On rocky canyon walls Rocky Mountain red cedar (*Juniperus scopulorum*), broad-leafed yucca (*Yucca Harrimaniae*) and a scrub oak (*Quercus*) are common. Along streams the narrow-leafed cottonwood (*Populus angustifolia*), alder (*Alnus tenuifolia*) and wild gooseberry (*Ribes*) are found. In restricted areas of this zone, on the lower hillsides, are piñons (*Pinus edulis*).

The plains, between 6,500 feet and 7,000 feet altitude, are characterized by grama grass (*Bouteloua*), narrow-leafed yucca (*Yucca glauca*), prickly pear and a cane cactus (*Opuntia arborescens*). In the drier areas, sage brush (*Artemesia*) and rabbit brush (*Chrysothamnus*) occur. Some hills below 7,000 feet have a cover of juniper (*Juniperus monosperma*). Narrow-leafed cottonwood and thickets of willow are found along the streams.

General trap lines were set out at the following places: Mountain meadow, 15 mi. SW Cimarron, 9,000 ft.; La Gruilla meadow, 16 mi. SW Cimarron, 9,500–10,500 ft.; Cimarroncito camp, 8 mi. W. Cimarron, 7,800–8,500 ft. dry hillside, 4 mi. SW Cimarron, 6,500–7,000 ft.; plains, 3 mi. SE Cimarron; 6,100–6,300 ft.

Most of the several associations were investigated a number of trap nights. Not all species of mammals expected were secured, but indications were found of several not represented by specimens.

SPECIES ACCOUNTS

Sorex obscurus obscurus Merriam.—Dusky shrews were common in the mountains; specimens were taken at 8,100, 8,500, and 9,000 feet in moist grassy places near water anP in the woods (both conifers and alders). The weights of most of them were 4.5 and 5 grams, but two old individuals, with well worn teeth, weighed 7 grams. No indication of breeding was found in July and August.

Myotis volans interior Miller.—Specimens were shot over meadows at 9,000 feet and in small open areas in the yellow pine-scrub oak association at 8,100 feet. They appeared at late twilight and were numerous. Weights of adult females were 7.5 and 9 grams, two adult males were 7 and 7.5 grams. In August the young were nearly full grown.

Eptesicus fuscus Beauvois.—Two large brown bats were shot, one at 8,100 feet, among yellow pines, the other over the open plains at 6,500 feet. The adult male weighed 22.5 grams, the young one was only slightly smaller. These individuals are not so pale as typical *E. f. pallidus*, but are somewhat intermediate between that race and the eastern race *E. f. fuscus*.

Lasiurus cinereus Beauvois.—Three hoary bats were shot, one at about 7,000 feet over the open plains, the other two at 8,100 feet in a clearing among the yellow pines. This was the middle of August, probably before migration. The bats appeared when it was quite dark, and were feeding. Two adult males weighed 20 and 24 grams; a young specimen (metacarpal epiphyses free) weighed 23.5 grams.

Canis latrans lestes Merriam.—The Rocky Mountain coyote is common here; two were secured and several others seen. A trapper employed on the ranch catches a large number each winter.

Procyon lotor mexicanus Baird.—The raccoon occurs commonly along the streams as high as the scrub oak zone. An individual was caught in a small trap set for rock squirrels and was trailed for some distance, but lost. Tracks were common along the Cimarron River at 6,300 feet and signs of their fishing for crayfish were seen, but no specimen was secured.

Bassariscus astutus flavus Rhoads.—A single specimen was killed September 4 by a rat

trap (cerebral hemorrhage from blow on the frontal). The trap was baited with a peanut butter-oatmeal-raisin-bacon mixture, and was set in a large rock pile at 7,800 feet in a sunny exposure. This individual probably had robbed traps of captured mice on several occasions. It was a female, with lactating mammae, two on each side of the abdomen. The animal weighed 874 grams.

Ursus americanus amblyceps Baird.—The black bear is common in the mountains from about 7,500 feet to timberline. Tracks were seen commonly along the streams where the bears came to fish in the shallow brook and, probably, to drink. The acorns of the scrub oak were a favorite food in September and individuals came some distance to feed on carrion. On two occasions bears were seen, once at night on the road in front of the automobile, at 7,500 feet elevation. The bear, a large black individual, ran in front of the headlights for several hundred yards but did not go faster than about 30 miles an hour, as measured by the speedometer. Its eyes gave a reddish reflection in the lights of the car. A young adult female and a cub were secured September 2 and 5 respectively. The former weighed about 200 pounds and was brownish black in color; mammae 2 —1= 6. A complete skull of an old bear, found in the canyon at 8,100 feet, measured 265 mm in length with a zygomatic breadth of 160.5 mm.

Ursus sp.—The grizzly bear is now quite or nearly exterminated in this region. A skin, in Mr. Phillips' collection, of a grizzly killed many years ago near Cimarron was dark brown with well-marked, pale yellowish overlay.

Mustela vison energumenos Bangs.—Mink occur in this area and have been trapped; but none was secured by the expedition.

Mustela frenata neomexicana Barber and Cockerell.—A single specimen was captured in a rock pile at 7,800 feet elevation, in the late afternoon. This was a young adult female and weighed 163 grams.

Mephitis mephitis varians Gray.—The skunk is fairly common on the plains, and several specimens were secured. None was fully adult; the largest weighed 1,594 grams.

Spilogale tenuis Howell.—A male spotted skunk was trapped in a rock pile at 7,800 feet The animal (a hind foot was missing) weighed 452 grams; it was not fully mature.

Taxidea taxus phippsi Figgins.—Badgers, probably referable to this race, occur in northeastern New Mexico from the plains up to about 10,500 feet. Rare on the plains, there were unmistakable signs of their presence on the high meadows, and cattlemen reported seeing them often. Traps set in the vicinity of recent diggings failed to secure an example.

Lynx rufus uinta Merriam.—The Rocky Mountain bobcat is fairly common near Cimarron, above 7,500 feet. Two specimens were secured by traps baited with decaying meat, and fresh signs of several others were seen. The larger of these, an adult male in good condition, weighed 16 lbs. 14 oz. (7.5 kilograms).

Felis concolor hippolestes Merriam.—The puma is reputed to be common in the higher parts of this area, but its abundance is probably overestimated. Mr. Wm. Whiteman reported seeing one in August at the head of Rayado Canyon, about 10,000 feet. No specimen was secured.

Felis onca hernandesii Gray.—A jaguar was killed some years ago near Springer; its skin is now in the collection of Mr. Waite Phillips. None has been reported from this region since then.

Sciurus aberti mimus Merriam.—Tassel-eared squirrels were fairly common in the yellow pine association, and were most active early in the morning. A series of ten was secured at Cimarroncito camp, 14 miles north of the type locality, Hall's Peak. A broad reddish brown marking is evident on the back of all adults, although its absence or reduced condition is said to characterize the race. The squirrels were feeding on the bark of yellow pine twigs and the ground under several young trees was covered with branch-tips. Mr. Gleaves stated that they dug up the seeds of crops planted in the vicinity. One was seen chased by the much smaller chickaree. An individual was followed up a tall, isolated yellow pine, in an attempt to get a close-up photograph. When approached too closely it sprang from the top of the tree, about 75 feet, flattened out as much as possible, fell with an audible

thud in the hard roadway, yet was up and running in an instant. The squirrels frequently prefer to escape by running on the ground, if there is adequate underbrush, rather than by climbing a tree. Mammae are in four pairs. Young ones, August 5, were one-third to about half grown. Adult males weighed 572 to 665 grams; females, 585 to 640 grams.

Tamiasciurus fremonti mogollenensis Merriam.—The chickaree occurs from an elevation of about 7,800 feet to timber line. It was not common in the yellow pine association, but was abundant in the fir-spruce forest. Two adult males weighed 219 and 230 grams; an adult female, 207 grams. Young of the year were all nearly adult in size in late July and August, but did not have permanent premolars in place.

Eutamias quadrivittatus quadrivittatus Say.—The Colorado chipmunk is abundant in both yellow pine and fir-spruce associations. It was trapped in dense woods, 8,000 to 9,000 feet, as well as in open park-like locations and in rock piles at 7,800 feet. Mammae were 2 — 2 = 8 in all cases. Males weighed 62 to 68 grams; females, 60 to 67.5.

Eutamias minimus operarius Merriam.—The lesser Colorado chipmunk was taken from 8,100 feet to 10,300 feet, chiefly in cool shaded places, but one was caught in an exposed rock slide, 8,600 feet, near red cedar and broad-leafed yucca. Others, probably of this species, were seen on the top of Clear Creek Mountain. Mammae are 2 — 2 = 8, and weights of adults were from 45 to 56 grams.

Citellus lateralis lateralis Say.—The Say ground squirrel was found from 8,100 feet to 10,500 feet, chiefly in the park-like areas. At about 10,000 feet one was photographed in a blue spruce, where it was feeding on the tender new tips of the branches. Next to *Peromyscus* and *Microtus* they were the most abundant mammal in the rocky edges of meadows and open aspen parks at 9,000 to 9,500 feet. A single young adult male was taken at 8,100 feet in a trap set on a log projecting into the creek. This was almost a mile from the nearest colony. Two males weighed 202.5 and 204 grams; five females, 193 to 274 grams. Young animals were in juvenile pelage as late as August 15, but were only a little smaller than the smallest animals with adult dentition and pelage.

Citellus variegatus grammurus Say.—Rock squirrels are moderately common in the scrub oak and yellow pine associations, a few were seen in the juniper zone also. Mammae (one female) were in four pairs. In August the young were about 80 percent grown as to head-body length, but weighed only a little more than half as much as adult females, which varied from 829 to 1103 grams.

Citellus spilosoma major Merriam.—One specimen of the spotted spermophile was trapped in the *Artemesia-Chrysothamnus* association, 4 mi. SW Cimarron; others were taken on the short grass plains, 3 mi. SE Cimarron. Weights of two adult females were 136 and 154 grams, no males were taken. Young (Sept. 12) weighed about one-third as much as adults, although head-body lengths averaged 123 mm as compared with 158 mm in the adult females. They had not yet erupted third molars and had milk premolars.

Citellus tridecemlineatus arenicola Howell.—Two specimens of the striped spermophile were taken in the *Artemesia-Chrysothamnus* association 4 mi. SW Cimarron. These were probably young of the year, but had permanent dentition and adult pelage. The spermophiles from west of the Cimarron Mountains, in Moreno Valley and adjacent high meadows have been referred to *C. t. hollisteri* (Howell, 1938, N. Amer. Fauna, no. 53, pp. 115–116).

Cynomys ludovicianus ludovicianus Ord.—The black-tailed prairie dog was common on the plains before poisoning campaigns were undertaken. Now they are rare, but farther south, near Wagon Mound, many were seen near the highway. They were extremely wary near Cimarron and only one was secured, a large female with five pair of mammae; she weighed 1,165 grams.

Cynomys gunnisoni gunnisoni Baird.—White-tailed prairie dogs were abundant in the high mountain meadows, 9,500 feet to 10,500 feet. A number were trapped, but no adults were taken this way. Two old males were shot; they weighed 1,016 and 1,017 grams. Adult females, also shot, weighed from 756 to 839 grams. Young were three-fourths as long as adults (July 20 to 26), but weighed only about half as much.

Castor canadensis concisor Warren and Hall.—Colorado beaver occur in the Cimarroncito creek from 9,000 feet down into the Plains. They are common in Rayado Canyon also. No specimens were taken, but skins in the collection of Mr. Waite Phillips are dark rich brown, like the Colorado beaver and unlike the description of either *mexicanus* and *frondator*. On the mountain streams the beaver dams hold up the runoff after heavy rains and decidedly help prevent erosion. Water from the creek branch unprotected by dams was muddy for days after a downpour, while shortly after such an occurrence the branch with numerous dams on it ran clean and clear. The hundreds of small mountain meadows doubtless owe their origin to the silt collected by beaver dams.

Thomomys talpoides fossor Allen.—Mountain pocket gophers were taken at 9,000 and 9,500 feet; signs of their work were seen in the mountain meadows near the top of Agua Fria Mountain at about 11,000 feet. Four embryos were found in a female July 18 and young taken July 17 were $\frac{1}{3}$ and $\frac{2}{3}$ the weight of adults. Many specimens were "crawling" with young ticks and some adult ticks were attached. Mammae were 2 — 2 = 8. Two adult males weighed 148 and 150 grams; four females, 119 to 138.5 grams.

Thomomys bottae pervagus Merriam.—Pocket gophers of the lower elevations near Cimarron were taken from 6,300 feet to 8,100 feet. Those from higher locations were taken in grassy open areas with scattered yellow pine, margined by scrub oak thickets. On the plains they are rare except around irrigated fields. These gophers are much brighter in color than *T. b. fulvus*, to which Bailey (1931, N. A. Fauna, No. 53) refers specimens from nearby localities. Mammae are usually 2 — 2 = 8 (in one case there were only 7). In August the young were from half grown to almost adult size; no embryos were found in adult females. Male adults weighed 140 to 159 grams; females, 93.5 to 135 grams.

Dipodomys ordii richardsonii Allen.—Plains kangaroo rats were taken from 6,300 feet to 6,800 feet in *Artemesia-Chrysothamnus* and short grass associations. A female, August 19, had two embryos, 12 mm crown-rump length; a few days later one was taken with four larger embryos. These probably represent a second litter. Mammae were 1 — 2 = 6. Males weighed 61 to 74 grams; females, 51 to 80 grams.

Perognathus flavus flavus Baird.—Dwarf pocket mice were secured as high as 6,700 feet in *Artemesia-Chrysothamnus* and short grass associations. Bird seed was the only successful bait and live traps were more effective than ordinary snap-traps. Males, August 20, had large testes. A female, September 13, had four large embryos. Adults weighed from 7 to 8.5 grams.

Perognathus hispidus paradoxus Merriam.—Three subadults (permanent premolar unworn) were taken Sept. 16, 17, at 6,300 feet. Their burrows were of large diameter and were almost perpendicular; in each case they were close to a dense growth of tall grass.

Onychomys leucogaster arcticeps Rhoads.—Several grasshopper mice were trapped in both *Artemesia-Chrysothamnus* and short grass associations. Males in adult and juvenile pelages, in August, showed scrotal, enlarged testes. A female had 1 — 2 = 6 mammae. Adult males weighed 42 to 46 grams; females, 41 to 52 grams. These all had the pinkish buffy adult pelage and had worn teeth; young of the year varied from 24 to 42 grams.

Peromyscus maniculatus rufinus Merriam.—The deer mouse is variable in this area, but coloration is not apparently correlated with environmental conditions. For the most part the mice are grayer than typical *rufinus* and decidedly paler. From trapping evidence they are the most abundant vertebrate in the yellow pine-scrub oak association, and probably the commonest in the entire area. Weights of ten adults (teeth worn), 18.5 to 26, average 22, grams.

Peromyscus nasutus nasutus Allen.—Sixteen long-nosed cliff mice were taken in rocky places from 6,700 to 8,600 feet. The lower altitudinal record was from an isolated hill with a low rocky outcrop, the higher records were from rock piles on the sides of the canyon wall. Weights of adults were 25 to 32 grams.

Peromyscus boylii rowleyi Allen.—Brush mice were trapped at 6,700 feet (Juniper association), 7,800 and 8,600 feet (rock slide, red cedar association) and one at 9,000 feet (yellow pine-scrub oak association). Adults weighed 21 to 25 grams.

Reithrodontomys megalotis aztecus Allen.—Four large-eared harvest mice were taken 4

mi. SW Cimarron in the *Artemesia-Chrysothamnus* association. One was captured and another was seen at dusk, 3 mi. SE Cimarron in a dry, weedy drainage ditch. The measurements of our specimens are nearly the average given by Howell (1914, N.A. Fauna, no. 36, pp. 30, 81) for *aztecus*. August 21, a female had seven small embryos (7 mm crown-rump length) and a male had enlarged scrotal testes. Mammae were 1 — 2 = 6. The weights were 12.5 to 15.5 grams.

Neotoma albigula warreni Merriam.—Four white-throated woodrats were taken on a rocky hill in association with *Peromyscus nasutus*, *Peromyscus boylii*, and *Neotoma mexicana* at 6,700 feet. Young adults (basal suture open, but in adult pelage) weighed from 184 to 224 grams. The hind feet have a larger naked area on the sole than *N. mexicana*. No houses of this species were found.

Neotoma mexicana fallax Merriam.—The gray-bellied woodrat is common in the yellow pine-scrub oak association. In each place this species was trapped it was associated either with *N. cinerea* or *N. albigula*. One small roofed nest, resembling that of a chickaree, was found in the lower branches of a balsam fir. A female ran out of it carrying two young ones attached to the nipples. The three were collected (August 11), the young weighed 39 and 40 grams, together almost half the weight of the mother. Other young (August 2 to 23) weighed 72 to 108 grams. Adult females, some gravid, weighed 116 to 195 grams; adult males, 144 to 222 grams. Two embryos were found in most of the adult females (August 11 to September 1), none had more. A majority of the others trapped were unquestionably young of the year. Mammae were 0 — 2 = 4. One specimen had a large warble on the rump.

Neotoma cinerea orolestes Merriam.—Bushy-tailed woodrats were trapped from 7,800 to 10,500 feet. They probably occur on the highest elevations in this area. One was seen at 4:30 p.m. and several were trapped in the daytime. Adult males showed an enlargement of the ventral thoracic nerve and blood vessels to the epithelial glandular area on the sides and underparts. One female (July 24) had three large embryos; no others were found with embryos. On July 18 young ones weighed about 100 grams; a month later those trapped were twice as heavy. Adult males weighed 322 to 388 grams; females, 250 to 280.

Clethrionomys gapperi galei Merriam.—One red-backed mouse was trapped at 9,000 feet, 15 mi. SW Cimarron, in mixed yellow pine and fir-spruce-aspen association. Many traps were set in situations usually favorable for this species, but no other specimens were secured.

Microtus pennsylvanicus modestus Baird.—A number of these meadow mice were trapped at 6,500, 9,000, and 9,500 feet in tall grass of moist meadows. Most specimens came from in or above the yellow pine zone; at the higher altitudes they were taken with *M. mordax*. July 28 a female had 7 embryos, 5 mm crown-rump length; another had 5 embryos about the same size. Mammae were 2 — 2 = 8. Males weighed from 40.5 to 52.5 grams; females, 31 to 47 grams.

Microtus mordax mordax Merriam.—Rocky Mountain meadow mice were taken from 8,100 to 9,500 feet. They were as common as *Peromyscus maniculatus* in the grassy woods (alder-cottonwood-willow) near Cimarroncito Creek at 8,100 feet. Males weighed from 40 to 60.5 grams, females 36 to 58 grams. July 28 a female had 7 embryos, 19 mm crown-rump length. Mammae were 2 — 2 = 8.

Ondatra zibethica osoyoosensis Lord.—Muskrats are common in the streams below 7,800 feet, but no signs were seen above this. No houses were found, but traps set under water in shallow narrows secured several specimens at 6,300 feet. They were richly colored individuals apparently referable to the mountain race. A young male, taken September 16, weighed 218 grams; an adult male, 844 grams.

Mus musculus Linnaeus.—Several house mice were taken at the base of an old haystack in a field, 6,500 feet altitude.

Erethizon epixanthum epixanthum Brandt.—A half-grown porcupine was shot August 11, at 8,500 feet, in a recess under some large rocks on the side of the canyon. Signs of these animals were seen from the highest part down to the piñon zone. A porcupine was killed by traffic on the highway north of Cimarron, about ten miles from the nearest trees.

Lepus americanus bairdii Hayden.—The snowshoe rabbit occurs in the vicinity of Cimar-

ron only in the higher spruce-pine forests, above 10,000 feet. Two specimens were shot July 28, at about 10,500 feet, on Agua Fria Mountain and others were seen at this level. The female carried three fetuses, 50 mm crown-rump length, and the mammae were in four pairs; she weighed 1,352 grams. The male weighed 1,104 grams.

Lepus californicus melanotis Mearns.—A single specimen of jack rabbit was secured and several were seen at 6,100 feet; they occur as high as 6,800 feet. Only moderately common and very shy, they were difficult to secure in this area. A young adult male weighed 1,920 grams.

Sylvilagus audubonii neomexicanus Nelson.—The plains cottontail occurs near Cimarron chiefly in the *Artemesia-Chrysothamnus* association; it is most commonly seen in prairie-dog towns, using the burrows of these animals as retreats. Several were shot at an elevation of 6,300 feet, and one was accidentally trapped—this was eaten to the footbones by an owl or a hawk. The ears are slightly longer, the hind feet shorter than in the mountain species. Young (September 1–15) were almost fully grown; the weight of a young adult male was 880 grams.

Sylvilagus nuttallii pinetis Allen.—The Rocky Mountain cottontail is found chiefly in thickets of scrub oak, but occurs from 7,500 to 9,500 feet at least. Most specimens were seen shortly before sunrise. The mammae are 2 — 2 = 8. Females weighed from 934 to 1,361 grams.

Odocoileus hemionus macrotis Say.—Mule Deer are common in the mountains on the Philmont Ranch, where they have received more than ordinary protection for years. In the fall and winter they come down on the plains. Until the party left the mountains, September 10, the deer were in their red coat but were shedding. Antlers of males were still in the velvet, but almost fully formed.

The American Museum of Natural History, New York.

NOTES ON THE MAMMALS OF MORROW COUNTY, OHIO

By Norman A. Preble

Morrow County is located in central Ohio at the extreme western limits of the Piedmont Plateau and near the southeastern limits of the Wisconsin glaciation. The eastern two-thirds of the area is essentially hilly and morainal in character, while the western portion is comparatively level. A striking feature of the Wisconsin drift is the presence of numerous kettle holes that have developed into a *Rosa-Cephalanthus* community. Such bogs were formerly more numerous, many having been destroyed in the process of clearing the land and subsequent drainage.

The eastern portion of the county is drained by the Kokosing River and its tributaries which have an aggregate permanent stream mileage of approximately 42 miles. Many of the small brooks are intermittent between the months of June and October. The western part of the county is drained by several streams comprising the Scioto drainage system. These aggregate 160 miles of permanent stream.

Much of the forested land is dominated by a beech-maple climax with elm, ash, red oak, white oak, and buckeye comprising the subdominants. On level and poorly drained soils there are remains of what were formerly extensive tracts of swamp-forest.

The first settlers arrived in Morrow County about 1815. Various portions of the county were not settled simultaneously for in the western and southern parts the land was originally poorly drained and with extensive swampy areas.

Between February, 1938, and March, 1940, the writer was employed by the Ohio Coöperative Wildlife Research Unit, Dr. Lawrence E. Hicks, Leader, in making a study on the status of raccoon in the county, and the following notes were taken during the course of that work.

LIST OF SPECIES

Didelphis virginiana virginiana Kerr. Virginia opossum.—According to Perrin and Battle (1880) the early settlers found opossums plentiful and it is doubtful that the original density has declined to any great extent, despite extensive hunting. This can be attributed to the great vitality of these animals and their ability to tolerate drastic changes in the environment.

During the 1938–39 fur season approximately 6,500 furs were taken in the county. Of these 1370, or 21.07 percent, were opossum. The average price per pelt varied from 15 to 30 cents.

This species is found throughout the county in all types of habitats. During the daytime use is made of hollow bases of trees or woodchuck dens.

A live opossum was discovered hiding in the base of a tree on May 10, 1939. The animal appeared throughly frightened, saliva exuding from its mouth and the whole body trembling quite perceptibly.

The average measurements of 5 adult females are as follows: Total length, 728.8 mm (600–817); tail vertebrae, 298.4 (255–355); hindfoot, 62.6 (55–70).

Melanism is not uncommon. Several animals tending toward this condition have been observed dead along the road and in fur houses. Highway mortality records kept for one year showed one opossum killed for each 36.44 miles of auto travel.

Scalopus aquaticus machrinus (Rafinesque). Prairie mole.—No specimens of the prairie mole were obtained, but runways were frequently observed in the woods and cultivated fields. Some objection is raised by farmers against these animals owing to their habit of tunneling along rows of corn and thereby exposing the roots.

Blarina brevicauda talpoides (Gapper). Short-tailed shrew.—I have found this species to be the commonest shrew in the area. Runways were common in bluegrass plots of roadside ditches and along the edges of the swamps. This species and *Microtus p. pennsylvanicus* and *Peromyscus leucopus noveboracensis* are the commonest small mammals. The average measurements of five adult males are: Total length 113.2 mm (104–120); tail vertebrae, 23 (22–25); hind foot, 15.6 (15–16). The subspecific name *talpoides* is used provisionally.

Eptesicus fuscus fuscus (Beauvois). Big brown bat.—No specimens of bats of any species were secured, but on several occasions this species was observed flying about the streets of Chesterville and over a small pond nearby. It was reported that bats roosted in some of the old buildings, but a thorough search during the spring of 1939 revealed none. Two specimens were found in a dwelling house, gaining access through the loose clapboards.

Euarctos americanus americanus (Pallas). American black bear.—According to the testimony of the early settlers black bears were not uncommon. Although hunted for fur and meat, they were not persecuted to the same extent as wolves. According to early accounts game of all types abounded in the county for about 20 years after settlement. I would infer that bears were probably extirpated from this region about 1830 or 1840.

Procyon lotor lotor (Linnaeus). Eastern raccoon.—Formerly common, but according to the testimony of all hunters in the county the native population is dwindling. The skins were worth 25 cents apiece in the early days and the revenue obtained was used to pay taxes. Five raccoons per night in favorable weather was considered a good catch.

Mustela rixosa allegheniensis (Rhoads). Allegheny least weasel. Probably not uncommon. A specimen is occasionally taken to a fur dealer under the common name of "stoat." A male obtained from a dealer in Knox County January 4, 1939, was pure white except for a few brown streaks about the head and nose. Measurements of this specimen were as follows: Total length, 192 mm; tail vertebrae, 32; hind foot, 23; ear 13.

Mustela frenata noveborascensis (Emmons). New York weasel—During the 1938–39 season, 152 pelts were sold to Morrow County dealers, constituting 2.33 percent of the total catch. Prices varied from 10 to 40 cents per pelt, the highest price being offered for large males.

Mustela vison vison (Peale and Beauvois). Common mink.—A stream survey conducted by members of the Ohio Cooperative Wildlife Research Unit in the five southeastern townships showed only five tracks of this species. During the season of 1938–39, a total of 270 animals were trapped in the county, or 4.15 percent of the total catch. Average price per pelt was 7 dollars. From these figures it appears evident that minks are by no means common in this portion of Ohio. One adult male and one adult female measured as follows: (male) Total length, 580 mm; tail vertebrae, 191; hindfoot, 63; (female) total length, 495; tail vertebrae, 178; hindfoot, 57.

Lutra canadensis canadensis (Schreber). Canada otter.—Perrin and Battle (1880) mention the tracking of an otter along the east fork of Whetstone Creek, near West Point. This is the only mention of the otter that I have been able to find.

Mephitis mephitis nigra (Peale and Beauvois). Eastern skunk.—According to the opinions of local residents and fur buyers, skunks have been decidedly reduced in numbers during the past two or three years. They attribute this entirely to disease, although the not uncommon practice of digging females from their dens during the winter has much to do with their decline in numbers. In 1938–39, 148 pelts were handled in the county, or 2.27 percent of the total catch.

Vulpes fulva fulva (Desmarest). Eastern red fox.—Foxes are common throughout the county. They are seldom trapped, only 21 being pelted during the 1938–39 trapping season. Prices discouraged trapping—varying from $1 to $3.50, depending on the size of the pelt. The chief value of the fox, in the opinion of the residents, is its use as an animal of the chase. The average weight of two males was 10 pounds. A yearling female weighed 8 pounds.

Canis lupus lycaon (Schreber). Eastern timber wolf.—The early settlers found wolves common. Large numbers were killed to protect stock and their scalps were legal tender in payment of taxes. During the winter of 1824–25, as a result of heavy snow, extreme decimation in numbers of deer resulted from lack of food and increased predation by wolves. A bounty of from $1 to $2 was offered for wolves over six months of age. Two melanistic specimens obtained from a hollow log are recorded from Chester Township. This species was probably extirpated by 1830.

Lynx rufus rufus (Schreber). Bay lynx.—At the time of settlement of Harmony Township in 1820, a few wildcats were to be found in the extensive swamps. Apparently they were not common. It is interesting to note that a wildcat was known as "panther" to the early settlers.

Marmota monax monax (Linnaeus). Southern woodchuck.—The forests of this county abounded with woodchucks and the first residents found ready use for their skins and flesh for shoes and food. I have found this species widely distributed throughout the county. Burrows are plentiful at the edges of cultivated fields and in farm woodlots. They are, however, not as abundant in wooded, rocky hillside habitats. They have been observed feeding at all hours of the day, being especially partial to clover. A number of basswood trees (*Tilia americana*) have been gnawed by this species. Russell Leedy, of North Liberty, Knox County, shot a ground hog on November 17, 1938. This appears to me to be rather late for this species to be active.

Citellus tridecemlineatus tridecemlineatus (Mitchill). Thirteen-lined spermophile.—Several colonies were located in Chester Township in the southeastern part of the county on gravelly, morainal pasture land. Another colony was found 2 miles west of Fredericktown

(Knox County) in a similar habitat, which appears to be near the eastern limits of this species in the United States. Three specimens collected during the week of May 8, 1939, proved to be males. They have been seen active during most of the day. On September 12, 1938, one crossed the road in front of my car at 9:30 p.m. From all appearances it had been feeding in a corn field nearby. This species is locally known as "Mexican gopher." Measurements of 3 adult males collected in Chester Township are as follows: Total length, 277 mm (274–282); tail vertebrae, 89 (84–92); hindfoot, 37 (36–39); ear, 12 (11–13). Weights of three adult males, 208.7 grams (190–220).

Tamias striatus fisheri Howell. Fisher chipmunk.—Owing to the wildness of southern and western chipmunks of this species, they were not commonly observed, although they are fairly common in the area. They are most frequently seen during the latter part of August and early September at which time they were active, storing the pits of cherry (*Prunus serotina*). All animals were observed in beech-maple forests.

Tamiasciurus hudsonicus loquax (Bangs). Southern red squirrel.—Red squirrels are common especially in bottomland timbered areas where they feed to a marked degree on the fruits of buckeye (*Aesculus glabra*). I was told by one hunter that he kills and eats all the red squirrels he sees.

Sciurus carolinensis carolinensis (Gmelin). Southern gray squirrel.—A resident of South Bloomfield Township tells me that gray squirrels have been absent from that locality for the past 15 years. Prior to 1925 he noted that they were gradually being replaced by fox squirrels, which were noticeably increasing. I have not seen gray squirrels in the county and numerous inquiries among resident hunters reveal that they are absent.

Sciurus niger rufiventer (Geoffroy). Western fox squirrel.—Fairly common throughout the county. Two dead animals were found in the woods. One was lodged 20 feet up in the crevice of a large elm and another, a juvenile, was found on the ground. I carefully examined both of them, but failed to find any evidence of gun shot wounds.

Castor canadensis canadensis (Kuhl). Canadian beaver.—In the northeastern portion of Harmony Township there was an old beaver dam enclosing about 30 acres of swampland. This dam was broad enough to provide the foundation for the first house built in the township. At the time the first settlers entered the county, beaver had been completely extirpated.

Peromyscus leucopus noveboracensis (Fischer). Northern white-footed mouse.—This species is abundant along the edges of small swamps. A series of 30 traps set for 1 night at the margin of a swamp in Harmony Township took 11 specimens of this mouse. It is also common in roadside ditches. Two specimens taken were parasitized with *Cuterebra* sp.

Synaptomys cooperi stonei Rhoads. Stone lemming mouse.—Synaptomys are common in the tall grass of wet pasture land (blue grass plots), being associated with *Blarina brevicauda talpoides* and *Microtus pennsylvanicus pennsylvanicus*. Skulls of this species have been noted in raccoon feces and owl pellets. I have observed them at all hours of the day running back and forth in their runways. They are not attracted by oatmeal bait as I have repeatedly seen them pay no attention to traps baited with it.

Microtus pennsylvanicus pennsylvanicus (Ord). Eastern meadow mouse.—This species was abundant at the margin of swamps, grassy swales, and roadside ditches.

Ondatra zibethica zibethica (Linnaeus). Common muskrat.—Muskrats are common along the rivers, especially at points where the current is sluggish and the water fairly deep. This is the most important fur-bearer of the county, constituting during the 1938–39 trapping season, 62.56 percent of the total catch. The price per pelt varied from 75 to 85 cents.

Mus musculus musculus Linnaeus. House mouse.—Common in houses.

Rattus norvegicus (Erxleben). Norway rat.—Common about buildings and dumps.

Erethizon dorsatum dorsatum (Linnaeus). Canada porcupine.—According to Perrin and Battle (1880) porcupine were common in the forests at the time of settlement.

Sylvilagus floridanus mearnsi (Allen). Mearns' cottontail.—Cottontails are common except in portions that are heavily wooded. Highway mortality is high. Records indicate one rabbit killed for each 12 miles of travel.

Odocoileus virginianus virginianus (Boddaert). Virginia deer.—The pioneers found deer plentiful, droves of 20 not being an uncommon sight. Perrin and Battle (1880) record that during the winter of 1824–25 snow fell to a depth of 20 inches and the deer, unable to find food, starved or became mired in swamps and were preyed upon by wolves. Five deer were considered an ordinary day's kill.

LITERATURE CITED

PERRIN, W. H. and J. H. BATTLE. 1880. History of Morrow County, 838 pp., C. L. Baskin, Chicago.

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TWO NEW BEAVERS FROM LABRADOR AND NEW BRUNSWICK

BY VERNON BAILEY and J. KENNETH DOUTT

In the summer of 1939 Mr. W. E. Clyde Todd, accompanied by the junior author and his wife visited the Grand Falls of Labrador to continue the study of the fauna of the Labrador Peninsula that has long been a special field for investigation by the Carnegie Museum. Since 1901, eighteen expeditions have been sent there to study and collect its plant and animal life. The 1939 trip was to extend from the Atlantic coast to the height of land, and was to connect with a previous traverse made from the Gulf of St. Lawrence to Ungava Bay.

The coast of Labrador, in the vicinity of Hamilton Inlet, is devoid of forest growth. It is, in fact, typical Arctic Zone. As one travels up Lake Melville, however, trees soon put in an appearance, and at Northwest River conditions approach that of the Canadian Life Zone. The Hamilton River flows through a deep valley in which the flora of the Canadian Zone is dominant. On the tableland above the river, however, conditions are typically Hudsonian. It appears, therefore, that the deep valley of the Hamilton River, below the Grand Falls, is an isolated area of Canadian Zone surrounded in the interior by Hudsonian Zone and along the Atlantic coast by Arctic Zone. A study of this fauna and flora yields interesting facts concerning the distribution, and effect of isolation, on animal life.

At the invitation of the senior author, the beavers collected on the expedition were taken to Washington, where they were compared with the material that the senior author had assembled in preparation for his book on the beavers of North America. This examination showed that the beavers from the Hamilton River represent an undescribed race which may be known as follows:

Castor canadensis labradorensis, subsp. nov.

Labrador Beaver

Type.—From Hamilton River, Labrador, 5 miles above Grand Falls; no. 17875, Carnegie Museum; female, two years old; collected August 12, 1939, by J. K. and M. T. Doutt, original number, 5607. *Paratype:* Skull only, from Freds Brook, near Grand Falls, Hamilton River, no. 18903, Carnegie Museum, adult male, collected March 30, 1940, by Cecil Blake.

Range.—Eastern Labrador in the Hamilton and Paradise Rivers, which drain eastward nto the Atlantic Ocean.

Characters.—Similar to *canadensis* but darker both above and below, almost as dark as

michiganensis; slightly darker than *acadicus*; head about as bright mahogany as *caecator*; nose and ears black.

Skull.—Of adult male slightly smaller than *canadensis* with distinctly lighter dentition, especially the molars; incisors brown, not yellow as in *caecator*. Skull more elongate and with heavier dentition than that of *acadicus*.

Measurements.—Of type in millimeters: Total length, 965; tail vertebrae, 350; hind foot, 170; ear from notch, 37. *Skull of paratype:* Basal length, 126; zygomatic breadth, 95.5; interorbital breadth, 26.8; nasals, 50 x 23; upper tooth row, 29.

Specimens examined.—Total number, 7, all from Labrador, as follows: Type and paratype near Grand Falls, Hamilton River; Gull Lake, Hamilton River, 1; Near settlement of Northwest River, Hamilton Inlet, 1 adult skull; 25 miles above Lake Winokapau, skin and skull of yearling, all in Carnegie Museum; 2 skulls from Paradise River, collected by Clarence Birdseye in 1915, U. S. National Museum.

The beavers of the lower St. Lawrence River drainage, New Brunswick and the Adirondacks are not typical *canadensis* nor the same as the Labrador or Newfoundland beaver. The extent of their original range will never be known, but enough old skulls and a few skins of native stock are available in the U. S. National Museum to give them a wide and logical distribution. They may well have been the beavers of the greater part of New York and Pennsylvania, now replaced by several introduced forms. The type series of 6 specimens, skins and skulls, collected by Kermit Roosevelt on the Nepisiquit River in eastern New Brunswick in 1911 give ample material for recognition of this long neglected race. One adult specimen taken from North Pond near Brandreth Lake in the Adirondacks in 1921 is so typical of the form that it must be considered a native rather than one of the introduced beavers then found in many of the lakes and streams. A fine adult skull collected at Raquette Lake in 1838, by John Constable, and given to Dr. Merriam, is unquestionably of native stock. A series of 21 skulls and a few skins collected for Dr. Merriam at Godbout, Quebec, in 1883–89, by Napoleon A. Comeau, are typical of this form, which may be designated as follows:

Castor canadensis acadicus, subsp. nov.

New Brunswick Beaver

Type.—From Nepisiquit River, New Brunswick, Canada; male adult, no. 174525, U. S. National Museum, collected September 25, 1911, by Kermit Roosevelt.

Range.—New Brunswick, Nova Scotia, southern Quebec, and Adirondacks in New York and originally probably in Maine and Vermont.

Characters.—A large, dark brown beaver very similar to *canadensis*, but not so bright colored; upper parts dark brown, lighter on head and around tail; belly dull brown. Skull slightly longer and narrower than in *canadensis* with generally narrower and more spatulate nasals. Molar series narrow but as long as in *canadensis*.

Measurements.—Of *type* in millimeters: Total length, 1,230; tail, 380; foot, dry, 160. A 44-pound male from Brandreth Lake, Adirondacks: Total length, 1,047; tail, 350 (naked part of tail, 280 x 156, dry); foot, 142. Skull of type: Basal length, 126; zygomatic breadth, 95; interorbital breadth, 25; mastoidal breadth, 62; nasals, 47 x 25; tooth row, 29. Skull of adult from Raquette Lake, Adirondacks, New York, no. 194055, U. S. National Museum, Merriam collection, collected by John Constable in 1838: Basal length, 133; zygomatic breadth, 102; mastoidal breadth, 67; interorbital breadth, 25; nasals, 48 x 24; upper tooth row, 33.

Specimens examined.—Total number, 34, as follows: **New Brunswick:** Nepisiquit River, 3 adult skins and skulls and 3 young, (U. S. National Museum). **New Hampshire:**

Charleston, 2 skulls. **New York:** Brandreth Lake (N. Pond), 1 skin and skull of adult; Raquette Lake, 1 skull of adult, collected by John Constable, 1838; St. Lawrence County, 1 skull. **Quebec:** Godbout, 21 skulls (U. S. National Museum); Lake St. Johns, 1 skull; St. Marguerite River, 1 skin and skull (Carnegie Museum).

1854 Kalorama Road, Washington, D. C. and Carnegie Museum, Pittsburgh, Pennsylvania.

NEW PTERONOTUS FROM NICARAGUA

By George G. Goodwin

Among the mammals collected in Nicaragua thirty years ago by William B. Richardson is a large *Pteronotus* which seems to represent an undescribed race. General comparisons indicate a uniformly larger size than its nearest relative, *Pteronotus suapurensis* from Venezuela. For this specimen I propose the name

Pteronotus suapurensis centralis subsp. nov.

Type.—No. 33193, Amer. Mus. Nat. Hist.; sex ?; adult; from Matagalpa, Nicaragua, 3000 feet elevation; collected by William B. Richardson, November 10, 1911. The type is a skin and skull in fair condition.

Diagnosis.—Similar to *Pteronotus suapurensis* Allen from Suapure, Venezuela, but larger. Forearm, 53.5 mm, as compared with 51 mm in *suapurensis*; claws and ears larger, and cranial measurements greater than the typical form.

Description.—Naked volar membranes extending over the back attached along medium line and across shoulders as in other members of this genus. Color: head and shoulders about Prout's brown, tips of hairs mummy brown; underparts slightly paler than back, hairs lightly tipped with pale buff in inguinal region. Skull like *suapurensis* but larger, with larger teeth and more inflated braincase.

Measurements of type (the type of *P. suapurensis* in parentheses).—Forearm, 53.5 mm (51); hind foot, in dried skin, 12 (11.5); third digit metacarpal, 48.9 (46.3); fourth digit metacarpal, 43 (40); fifth digit metacarpal, 40 (37.8). Skull: greatest length, 17.9 (17.2); condylobasal length, 16.5 (15.7); zygomatic breadth, 10.5 (10); width of braincase above zygoma, 8.7 (8.5); interorbital constriction, 4.2 (4.2); width of rostrum 7.9 (7.7); depth of braincase, 7.5 (7.3); width across m^3 and m^3, 7.2 (6.8); length of maxillary toothrow, c-m^3, 7.5 (7.3); lower toothrow, c-m_3, 8.2 (7.8).

In the single specimen of *P. s. centralis* the measurements are uniformly greater than any in a series of twelve *suapurensis* from Venezuela. Its dark color is probably dichromatic but its large ears, wings, and feet distinguish it externally from the Venezuelan race. *P. s. centralis* needs no comparison with *P. davyi* from Trinidad and *P. d. fulvus* from southern Mexico, the skull in bulk being larger than the former by fully one third and twice as large as the latter.

I hesitated before basing *centralis* on a single specimen as its principal distinguishing characters are mainly in size and the actual differences in measurements between *centralis* and *suapurensis* are not very great. The two races are readily separable, however, when specimens are compared. The type of *suapurensis* is an old female with worn teeth and represents near the maximum in size of the series of males and females from Venezuela. The Nicaragua specimen is an adult with teeth showing little wear. These two localities are widely separated geographically and the recognition of a Central American race seems justifiable. J. A. Allen, who saw this specimen and doubtless compared it with the Venezuelan series, was unable to identify it with *suapurensis* and questioned the identification on the label.

American Museum of Natural History, New York, N. Y.

GENERAL NOTES

FURTHER MISCELLANEOUS NOTES ON AMERICAN MANATEES

In a recent communication (Gunter, 1941) the writer set forth information indicating that manatees probably have never been permanent residents of the northern Gulf Coast or the South Atlantic Coast of the United States, north of Florida, at least in recent times. Dr. Robert T. Hatt recently suggested in a letter that excavation of Indian shell heaps on this coast might yield manatee bones. Such excavations have lately been made on the shores of Copano Bay by Mr. W. A. Duffen for the Texas Archaeological Survey. Some of the sites were Pre-Columbian and presumably they were left by the Karankawas or related tribes. No manatee bones were found and this isolated fact tends to corroborate the conclusion that the animals were never common on this coast. Mr. Duffen found only one probable bone of the Bottle-nosed Dolphin, *Tursiops truncatus*, a common animal in the bays. Gatschet (1891), whose information goes back for a hundred years earlier than today, says that although the bays teemed with porpoises, they were not eaten by the Karankawas. Obviously then, little weight can be given to negative evidence in the case of the manatee.

The writer cited the record of Brimley (1931) showing that the manatee sometimes goes as far north as North Carolina. The statement of Nelson (1916), based presumably on a record not given in that paper, that manatees stray as far north as Virginia during the summer was overlooked.

The most obvious barrier to the northward extension of the manatee is its inability to withstand cold and the writer concluded that this factor kept it from becoming a permanent resident of the northern coast of the Gulf of Mexico. Rather corroborative of this idea is the fairly well substantiated fact that manatees migrate northward in the summer and leave when winter approaches. Bangs (1895) said manatees in the Indian River of Florida migrated farther south for the winter and returned in early spring. All animals reported from Texas in recent years were seen in the summer. Probably American manatees never winter north of areas normally free of cold waves or cool spells. This would preclude their presence in any part of Texas during midwinter. Manatees are sometimes killed in their normal winter range in Florida, however, as is recorded several times in the literature. A recent unrecorded instance was brought to my attention by Mr. J. C. Galloway of Port Allegany, Pennsylvania. During the cold spell of January 1940, a manatee succumbed in the Peace River, near Cleveland, Florida, and the body was stranded by the tide. The estimated weight of the animal was 600 pounds. Mr. James O. Stevenson of the Aransas Refuge, Austwell, Texas, showed me an unpublished manuscript of the late Arthur H. Howell which states that four manatees were killed at that time on the Peace River, the bodies being found in Charlotte Harbor.

Anthony (1928) gave the weight of a Florida male manatee, length seven feet and six inches, at 432 pounds. This compares well with Townsend's (Zool. Soc. Bull., N. Y., vol. 18, no. 6, p. 1216) figure on a Porto Rico specimen, which was seven feet and seven inches in length and weighed 437 pounds. Gunter (*op. cit.*) quoted notes on a Texas specimen that was said to be fifteen feet and three inches long with a weight of 1,310 pounds. These figures contrast with estimates of 1,000 pounds for a nine foot and two inch specimen (Barrett, 1935); well over a thousand pounds (estimates from photographs and eye-witness accounts) for a specimen ten feet and four inches long (Gunter, *op. cit.*); and 2,000 pounds for a Florida animal twelve feet long (Bangs, 1895). Either the weight-length relationship of manatees is extremely variable, the weighed captive animals were in poor condition, or some of the estimates in the literature are very inaccurate.

For years it has been a matter of common knowledge with conservationists and mammalogists that manatees are very uncommon in the United States. Ingersoll (1907) stated that they were formerly plentiful on both coasts of Florida but that "now" only a carefully guarded few remained near Miami. Bangs (1895) said that the Florida population started to decline twenty-three years before he wrote and that the animals had been protected by

law for the "past two years." In brief, Florida manatees have been rigidly protected by law for almost fifty years because of their diminished numbers. For that reason it is both remarkable and regrettable that one of the latest and most modern American textbooks on vertebrate zoology, Newman (1939), contains the following statement, p. 452: "The manatees are fairly abundant along the south Atlantic coasts of North America and Africa. They are said to be especially numerous among the lagoons of the Florida Coast. The use of their flesh has been strongly urged, for they feed upon nothing but sea weeds, of which there is an inexhaustible supply. Their flesh is said to compare favorably with beef." It is to be hoped that this error will be corrected in future editions of the book.

LITERATURE CITED

ANTHONY, H. E. 1928. Field Book of North American Mammals. xxv + 625. Putnam's Sons, New York.

BANGS, OUTRAM. 1895. The present standing of the Florida manatee, *Trichechus latirostris* (Harlan) in the Indian River waters. The Amer. Nat., vol. 29, pp. 783–787.

BARRETT, O. W. 1935. Notes concerning manatees and dugongs. Jour. Mamm., vol. 16, pp. 216–220.

BRIMLEY, H. H. 1931. The manatee in North Carolina. Jour. Mamm., vol. 12, pp. 320–321.

GATSCHET, ALBERT S. 1891. The Karankawa Indians, the Coast People of Texas. Archeological and Ethnological Papers, Peabody Museum (Harvard), vol. 1, no. 2, pp. 69–167.

GUNTER, GORDON. 1941. Occurrence of the manatee in the United States, with records from Texas. Jour. Mamm., vol. 22, pp. 60–64.

INGERSOLL, ERNEST. 1907. The life of Mammals. xi + 555. Macmillan Co., New York.

NELSON, E. W. 1916. The Larger North American Mammals. National Geographic Magazine, vol. 30, pp. 385–472.

NEWMAN, H. H. 1939. The Phylum Chordata. xii + 477. Macmillan Co., New York.

GORDON GUNTER.—*Game, Fish and Oyster Commission, Rockport, Texas*

NESTS AND HABITAT OF THE GOLDEN MOUSE IN EASTERN KENTUCKY

Very little has been published relative to the life history of the Golden Mouse (*Peromyscus nuttalli nuttalli*). This beautiful little creature is relatively abundant in certain areas of Eastern Kentucky, notably so in the vicinity of Morehead, Rowan County, and it was here that this investigation was made. During three successive years attempts were made to breed the animals in captivity, but without success.

Golden mice were most often found in moist thickets. The dominant plants of the most frequently used habitats were several species of maples, oaks, gums, hickories, and pines. Greenbrier (*Smilax rotundifolia*) was almost always a conspicuous part of the flora. The mice were sometimes taken on dry hillsides in purely deciduous thickets, but they were much more abundant in the former type of habitat.

Nests were found in a great many situations at distances varying from a few inches to ten feet above the ground. One nest, containing an adult mouse, was located on the ground under a pile of logs. Possibly this nest had been built by some other species and the golden mouse was merely there temporarily. To show the variation in the location of the nest, a few situations are mentioned: Eight feet high in a mass of greenbrier; 4 feet high in the branches of a strawberry bush; 10 feet high in a mass of grape vines; the top of a freshly cut pine; 6 feet high in the branches of a freshly cut sycamore; 10 feet high against the trunk of a small pine; 1 foot high in the branches of a small sumac; 3 feet high in the branches of a sumac; and 8 inches high in the branches of a small oak. These are but a few of many nests observed.

Apparently the golden mouse builds two types of nests, one for shelter and the other for rearing young. The former nests were oval or globular, with outside measurements in one extremely large nest as great as 9 by 12 inches. However, the majority of nests of this type

were globular, with an outside diameter of from six to eight inches. This type of nest was perhaps most often found in the branches of a large fallen pine, to which the needles were still adhering. These nests often contained a surprising number of mice. One contained eight adult mice, another seven, another six, and several contained up to five mice. In the case of the nest containing eight mice, all were captured, and all proved to be males.

The nests that are apparently built for the purpose of rearing young were considerably smaller than the "shelter" nests, and were usually located in a tangle of greenbrier, a small pine, or a deciduous bush. In several instances two mice, a male and a female, were taken from one of these nests. On other occasions, however, as many as four adults have been taken from one nest that was similar to the breeding nests. Apparently the two nest types are not distinctly separable.

The majority of the nests were constructed of dead leaves and pine needles, and lined with finely shredded bark and leaves. Shredded bark was by far the dominant feature of the nest lining. In one area, several nests were found that were lined with feathers.—Roger W. Barbour, *Dept. Conservation, Frankfort, Kentucky.*

A SURFACE NEST AND THE YOUNG OF SIGMODON IN TEXAS

A surface nest of the cotton rat (*Sigmodon hispidus texianus*) was found at College Station, Brazos County, Texas on October 3, 1940. It was located in a dense stand of "lodged" grasses (*Andropogon scoparius, Sorghum halpense*, and *Paspalum* sp.) on the edge of an ungrazed field dominated by scattered post oak (*Quercus minor*) and bordered by an intermittent creek. The *Andropogon* and other grasses averaged 32 inches in height in the immediate vicinity of the nest but 16 inches in a nearby area where moisture conditions were not so favorable.

The nest itself was made of grass culms and blades (*Andropogon, Sorghum*, and *Paspalum*) cut into irregular lengths of 2½ to 3 inches, comprising a small handful of material, placed in a small depression in the ground about 2½ inches deep by 4¾ inches in diameter. The soil, Lufkin fine sandy loam, was more moist at the nest than in nearby areas. This probably was due to the heavier growth of grasses in the immediate vicinity and to the fact that the nest was located at the base of a slight slope adjacent to the stream course. This nest was more exposed for a nest containing young than that indicated by Streaker (Jour. Mamm., vol. 10, no. 3, p. 218) who implies that the young are brought forth in underground nests.

An adult and 10 young were found in the nest when it was discovered. Bailey (N. Amer. Fauna no. 25, 1905, p. 115) refers to Gaut's record of a female containing 8 embryos. The available literature does not indicate more than 8 young for *texianus* although Bailey (*loc. cit.*, p. 118) records an old female (*Sigmodon hispidus berlandieri*) from Carlsbad, New Mexico that contained 11 embryos. Svihla (Jour. Mamm., vol. 10, no. 4, pp. 352-353) has described the young of *Sigmodon*, which he apparently raised in captivity. He spoke of the fact that they were quite active at an early age and that their eyes opened before they were 24 hours old. The young in the present case did not have their eyes open and were not very active, being able to clamber around the nest in a slow and awkward manner. The gray hair covering them was longest on top of the head. The average length of the 6 males was 76.6 mm, whereas that of the 4 females was 74.2 mm. Standard measurements of the largest male were 80-25-12-5 mm. When picked up the young emitted frequent, high-pitched, one-noted squeaks, which attracted an adult to within a few feet of the nest. The young are preserved as alcoholic specimens at the Texas Wildlife Cooperative Collection, College Station, Texas. The help of Dr. W. B. Davis in sexing the litter is gratefully acknowledged. —Arthur F. Halloran, *Texas Cooperative Wildlife Research Unit, College Station, Texas.*

CHIPMUNKS KILL BIRDS IN BIRD TRAPS

In the November 1940 Journal of Mammalogy A. R. Shadle reports on wild rodents using animals killed by automobiles for food. In ten years of bird banding at Mohonk Lake I have had perhaps two dozen cases of the eastern chipmunk, *Tamias striatus* entering a closed bird trap and killing a bird inside. In cases where it was an automatic trap access was gained by digging under the edge of the wire. Circumstantial evidence led me to think

that the animals were after the birds and not the trap bait. In several cases chipmunks entered the back compartments of government sparrow traps (with wire screen floors) and killed birds. In these they must have gone past bread crums or cracked corn bait in the first compartment of the trap. Once an individual started to develop the killing habit apparently with the same lust as the weasel.

The birds killed were juncos, song sparrows, and tree sparrows. Generally we found them bitten in the back of the skull. Sometimes nothing was eaten, but more frequently the brain had been consumed. Occasionally flesh was eaten from the breast or back.—Daniel Smiley, Jr., *Mohonk Lake, N. Y.*

THE CAVE BAT AS THE FOOD OF THE CALIFORNIA LYRE SNAKE

On September 5, 1937, a party of miners, upon entering a mine tunnel in the Riverside Mountains, Riverside county, California, discovered a snake coiled beside the mine car track on the floor of the tunnel. The snake, which measured approximately three feet in length, seemed to be in distress as though suffering from an injury. Closer examination revealed a large object lodged crosswise in the throat region of the snake. The obstacle was approximately two inches in length and seemed to resemble a small twig. The skin of the snake's neck was drawn very taut at this point and this was undoubtedly the source of the reptile's discomfort.

The snake was placed in a wooden box with window screen nailed securely over the opening. The box was then delivered to me in Los Angeles and upon removing the screen I found a very lively specimen of the rare and little-known California Lyre snake (*Trimorphodon vandenburghi*), of the southwest deserts. In the box with the snake was the disgorged body of a bat, which proved to be an Arizona cave bat (*Myotis velifer velifer*), a species known to inhabit the above mentioned tunnel in large numbers.

From the careful description of the miners, it was evident that one of the radii of the bat had become lodged crosswise in the snake's throat, making it impossible for the reptile to finish swallowing its prey. The excitement of capture and the transportation to Los Angeles had evidently caused the snake to disgorge the bat, thus relieving its distressed condition.—Kenneth E. Stager, *4300 Budlong Avenue, Los Angeles, California.*

ANTELOPE WITH LOCKED HORNS

It is not uncommon to find two buck deer with antlers locked while fighting, resulting in the death of one or both animals, but such a thing is most unusual for buck antelope.

During the summer of 1940, Tom McQuaid, a stockman in South Park, found two of these graceful animal with their heads firmly locked and both dead. A battle had taken place at a salt ground in the south end of South Park.

The right horn on one buck was about half as long as the left and ended in a fork with two short, straight prongs. The left horn was normal and ended in the usual hook or curve which was turned in toward the other horn rather than backward.

When the two bucks charged each other on the salt ground the short freak right horn of the one pierced the hide and became embedded between the forks of the other buck's lower jaw near the base of the tongue. The other, or left horn, the tip of which curved in, was forced past and on the outside of the other buck's right horn and became locked there.

The embedded freak horn held the hooked horn in place and the latter being hooked from behind, prevented removal of the embedded horn. Evidence showed that the two had struggled over quite an area before both died.—C. C. Spencer, *Pike National Forest, Colorado Springs, Colorado.*

UNUSUAL PELT MUTATIONS OF THE MUSKRAT

Muskrats in common with many other kinds of mammals of the temperate and frigid zones have the equivalent of two coats of hair that protect them not only from cold but aid in shedding water quickly, thus keeping them dry next to the skin. The outer coat is

formed by the numerous long, coarse guard hairs that are scattered throughout the shorter underfur. During the 1940 muskrat trapping season two specimens of *Ondatra zibethica macrodon* were taken on the Blackwater National Wildlife Refuge, located ten miles below Cambridge, Md., that represented a distinctly new appearance in the pelt structure. These aroused great interest among the local trappers and fur buyers as nothing even closely resembling it had been reported heretofore out of the millions of muskrats that have been trapped and sold over the country.

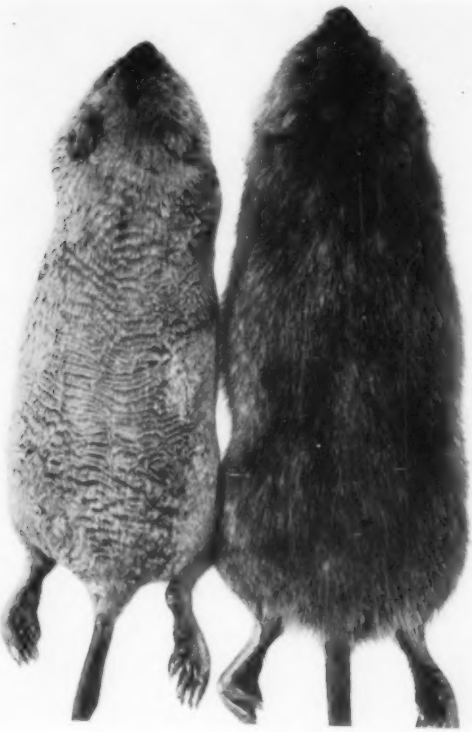

FIG. 1. Permanent-waved female muskrat (left) contrasted with normal brown (right). Blackwater Refuge, Md., March 6, 1940.

The first of these unusual muskrats was a mature male, trapped by Russell Insley on February 18, 1940, on Twin Ponds marsh; the second was a female, weighing 2 lbs. 2 ozs., caught by Cecil Moore on March 6, 1940, on Sunken Island marsh along the river about two miles distant from the spot where the male was trapped. Both of these were brown in color although differing somewhat in shade. All of the customary long guard hairs, normally present, were completely lacking and the short hair was rippled or wavy, very soft in texture, with a beautiful silky sheen. That of the female was distinctly more waved and in a manner quite similar to the permanent-wave that is usually obtained only in a beauty shop.

If animals of this rare mutation could be obtained alive, the trait established by selective breeding and its durability proven, it would probably be welcomed by the fur trade as a novelty. The term "Samson" has been applied to a somewhat similar type of mutation that occurs occasionally in both wild and ranch-raised fox. In these mutations the guard hairs are also missing, involving part or all of the pelt, but the underfur is woolly, without lustre, and highly undesirable from a breeding or furrier's standpoint. The cause of such a condition in case of the "Samson fox" has often been attributed to feeding and disease but experiments conducted by the U. S. Fur Animal Experiment Station, Saratoga Springs, New York, indicate that the characteristic is inherited. Probably it will also prove to be a genetic factor in the case of the muskrat.—HERBERT L. DOZIER, *U. S. Fur Animal Field Station, Blackwater National Wildlife Refuge, Cambridge, Maryland.*

WARBLES IN PEROMYSCUS LEUCOPUS NOVEBORACENSIS

In late summer and early autumn, 1939 and 1940, a severe warble-fly infestation was noted in *Peromyscus leucopus noveboracensis* during a systematic survey of mouse populations on the Moingona Wildlife Research Area near Boone, Iowa. Adult warble-flies were never observed on *Peromyscus* nor were their eggs found attached to the hairs of the host. The larvae, however, were obviously *Cuterebra* and one was identified as *Cuterebra fontinella* by C. T. Greene of the United States Bureau of Entomology and Plant Quarantine.

As determined externally, the first mouse parasitized by a warble-fly larva was trapped August 1, 1939, and in 1940 on July 4. In 1939 a larva was still present in one individual on October 6. The occurrence and severity of the infestation are shown in the tabulation below. Burt (Misc. Publ. Mus. Zool. Univ. Mich., vol. 45, pp. 1–58), during a study of small mammals in southern Michigan, did not find warble-fly larvae in *Peromyscus leucopus noveboracensis* in 1935, but in 1936, 0.7 percent of the population was parasitized and in 1937 the percentage had increased to 3.4.

Percent of Animals Parasitized, Sample Plots

	July	*August*	*September*	*October*
1939	0.0	16.7	35.7	3.2
1940	5.3	2.6	29.9	Did not trap

A few case histories from 1940 may be cited to aid in determining the period of occurrence. A warble-fly larva was noted in one animal on July 12 but when retrapped on July 18 the larva had emerged, leaving an open, festering wound. In another animal the larva was not noticeable on July 24 but when again taken on August 2 it was easily discernible. In one case a larva was not seen on August 15, but one was obviously present on August 27. On August 10 one animal was free from larvae; on September 2 a larva was noticeable, and when last examined on September 19 it was still parasitized. A wound from a warble-fly larva was observed in one individual on September 10, although evidence of parasitism was not recorded during a previous examination on August 14.

Although one was the usual number of larvae to a host, two and even three were recorded. Throughout 1939 no more than a single larva was found in any of the animals examined. These were all located in the area of the body normally infested, the abdominal wall. Of the animals trapped in 1940 two contained two larvae. In one of these cases the larvae were typically located in the abdominal wall, whereas in the other, one larva was in the abdominal wall and one was in the flank. In each instance there was a difference in the size of the two larvae, and thus, presumably a difference in their age. No evidence of parasitism was recorded for one mouse when trapped on August 10; however, three larvae were present when it was again handled on September 8. Two of the larvae were in the abdominal wall and one was in the flank. Here, too, there appeared to be a difference in the age of the parasites, for the larva in the flank was noticeably smaller than those in the abdominal wall; and of the latter, although similar in size, one was emerged for one-third its total length.

Parasitism was found represented in all age classes from immature animals, barely able

to visit the traps, through adults. The most severe infestation, however, was found in adults. This was demonstrated in September, 1940, when 16.7 percent of the young were parasitized and 42.1 percent of the adults contained larvae.

In addition to *P. l. noveboracensis* no other species was found infested except *Mus musculus*. Of seven of these animals trapped in August and September, 1940, two contained larvae. One individual carried two larvae, and the other had a larva and the characteristic wound of an emerged larva.

The effect of the parasite on the population is difficult to establish. The large larvae produced an obvious awkardness in the locomotion of parasitized mice, possibly decreasing their efficiency in escaping predators. Retaining in mind the remoteness of the probability of finding the body of so small an animal, the following records may prove of some significance. On September 26, 1939, the warble-infested body of a *P. l. noveboracensis* with skull crushed and fur mouthed after the manner of the red fox (*Vulpes regalis*) was located on a stock trail in the area. Analysis of a cat scat that may be dated for the period, September 12–16, 1940, revealed the remains of *Microtus*, *Peromyscus* and *Cuterebra*. A scat of the red fox defecated October 1 or 2, 1940, contained among other items the remains of a young *Peromyscus* and *Cuterebra*. On September 4, 1940, a pregnant female *P. l. noveboracensis* with an open, pus-filled wound in the abdominal wall near the anus was found. The mouse bore no marks other than this wound, certainly that of an emerged warble-fly larva. It is possibly of some importance, too, that a few enemies of the mice feed more on fruit and insects during the summer and early autumn than on mice.

A downward trend was evidenced in the population of *P. l. noveboracensis* during September of each year as indicated in the following tabulation. The figures appear low because the plots in the purposive sampling of the area included such barren areas as plowed fields and closely grazed pastures. Although this is contemporaneous with the period of most

Number of Mice to the Acre, Sample Plots

	June	*July*	*August*	*September*	*October*
1939	.22	.39	.78	.65	1.30
1940	1.66	1.19	2.45	1.23	

severe warble-fly infestation, it is of course unreasonable to attribute the loss to parasitism alone. It may be largely a result of the usual late summer lull in breeding activity. Other complicating factors are no doubt present, however, for in September (1940) while the numbers of adult animals decreased by roughly 56 percent the numbers of young fell off only about 30 percent. As the percentage of animals parasitized is greatest in the adult class and as a lull in breeding activity would affect only the numbers of young it appears that the warble-fly infestation might have contributed to the September mortality of *P. l. noveboracensis*.—Thos. G. Scott and Edwin Snead, *Iowa Cooperative Wildlife Research Unit, Iowa State College, Ames, Iowa.*

PRIBILOF FUR SEAL TAKEN IN SAN DIEGO COUNTY, CALIFORNIA

Recent capture of an adult female Pribilof Fur Seal (*Callorhinus ursina cyanocephala*) at Ocean Beach, within the municipal limits of the City of San Diego, establishes the third record for this species on the California coast. It was found, exhausted and helpless, in a pot-hole below a sandstone cliff on January 29, 1941, and was taken to the San Diego Zoo. In spite of the best care by Dr. C. R. Schroeder, Veterinarian of the Zoo, it died on February 6. Through the kindness of Mrs. Belle J. Benchley, Executive Secretary of the Zoo, and by permission of the U. S. Fish and Wildlife Service, the body was turned over to the San Diego Natural History Museum, where the skin and skeleton have been preserved. The animal was very emaciated, with scarcely a vestige of fat, and weighed 77 lbs.

A post-mortem examination by Dr. Schroeder revealed a serious pathological condition of the adrenal glands, but more unusual, and probably the cause of death, was the fact that the stomach was filled with a spongy, glutinous mass of feathers totalling almost a quart. There was nothing else in the stomach. This mass had seemingly been troubling the seal

for some time, as numerous mucous ulcers were found in the stomach and first section of the small intestine, probably caused by the irritation of the feathers and quills. Furthermore, when the mass was washed and separated, many of the feathers were found with half-developed shafts, showing that they had been in the process of growing. Since most sea birds moult in the late summer, these feathers had presumably been in the seal's stomach since September or October.

Unfortunately it has been impossible to identify the feathers with certainty. The writer is of the opinion that they were all from a single bird, which seemed to have been about shearwater size. In any event, the avian diet of the seal is of considerable interest, birds being not mentioned as eaten by seals in any reference located by the writer. Speculation suggests that this particular animal, weakened by its adrenal disturbance, was starving and seized food that was unnatural—just how would be a matter of guess-work. It is known that fur seals regurgitate fish-bones after the flesh has been digested something after the manner in which the hair and bones of mice are ejected by birds of prey (see Lucas, *in* Fur Seals and Fur Seal Islands of the North Pacific Ocean, Part 3, p. 65, Washington, 1899), but the mass of indigestible feathers was seemingly beyond this seal's power to eliminate. It is worthy of note that the stomach contained no stones such as are almost always found in the stomachs of seals and sea-lions. These have usually been supposed to aid in grinding the food, but they may also provide a weight balance, to aid the stomach muscles in ejecting masses of light fish bones.

The other two fur seals recorded from the California coast were taken much farther north, one at Monterey in 1925 (Bonnot, Calif. Div. Fish and Game, Fish Bull. 14, p. 16, 1928) and the second near Crescent City on May 25, 1939, (Hall, Calif. Fish and Game, vol. 26, no. 1, p. 76, Jan., 1940). They also were both females and the first was reported to have been bitten by a shark, the other to have been in an emaciated condition, like the one described here. It is evident that only physical misfortune would cause an ocean migrant that is as strong a swimmer as the Pribilof Fur Seal to come ashore in the latitude of California.—LAURENCE M. HUEY, *San Diego Society of Natural History, Balboa Park, San Diego, California.*

MYOTIS KEENII SEPTENTRIONALIS (TROUESSART) IN MARYLAND

On February 16, 1941, an adult male *Myotis k. septentrionalis* was captured in a deserted chrome mine at Bare Hills, Baltimore County, Maryland. Work stopped at this mine during the early 1900's and now it has water flowing through it sometimes to a depth of three feet. The *Myotis* was discovered hanging head downward from the roof of the mine approximately 25 feet from the opening. Its hind feet were thrust into a crevice and in that position it was 4 to 5 feet above the surface of the water with its face directed toward the light coming from outside. When first observed its fur was dotted with "dew"; the air temperature at the spot where the bat hung was 7.5° C (outside of the mine the air temperature was 2.3° C). The bat's eyes were tightly closed, but when the writer grasped it in his fingers it squeaked and bit his thumb almost immediately.

This specimen is now no. 270235 in the U. S. National Museum where its identity was affirmed by Dr. G. S. Miller, Jr.

A futile search for another one of this uncommon *Myotis* was made. Close by the spot where the *Myotis* was collected, however, ten adult *Eptesicus fuscus fuscus* (Beauvois) were observed resting side by side in a large crevice with their faces directed toward the opening.—ELIAS COHEN, *University of Maryland, College Park, Maryland.*

SKRJABINGYLUS CHITWOODORUM FROM THE FRONTAL SINUSES OF MEPHITIS NIGRA IN NEW YORK

On the afternoon of March 25, 1941, Mr. H. Bixby observed a skunk running in circles and tumbling about, near Schenectady, N. Y. The animal died during the night and Game Protector Chester Griffith sent it to the Laboratory of Wildlife Pathology for examination.

Autopsy revealed that the skull and mandible were fractured and infection involved the tissues adjoining the break in the latter. Examination of the frontal sinuses revealed the presence of three male bursate nematodes and fragments of two females. Some chronic

sinusitis was apparent but death was attributed to the effects of mechanical injury and subsequent infection.

The worms were identical with *Skrjabingylus chitwoodorum* Hill in all observed morphological characters. It is interesting to note, however, in reporting this parasite from *Mephitis nigra* in New York, that the measurements were greater than those reported by Hill (Jour. Parasitol., vol. 25, pp. 475–478, 1939) from *Mephitis mesomelas mesomelas* and *Spilogale interrupta* in Oklahoma. The three males measured 19, 19 and 22 mm in length as compared with Hill's 13 to 17 mm. The spicules measured 715, 795 and 830 micra while Hill's ranged from 540 to 710. The two females were removed in six fragments totalling 70 mm, giving an average length of 35 mm. Hill reported three females measuring 29, 23 and 27 mm in length.

Stegeman (Jour. Mamm., vol. 20, pp. 493–496, 1939) reported dilatations at the junction of the frontal and parietal bones of a number of New York skunk skulls and quoted G. S. Miller, Jr. (Proc. Boston Soc. Nat. Hist., vol. 28, pp. 1–44, 1899) as reporting similar disfigurements in a large proportion of specimens of North American mustelids. Parasites collected by Miller in Ontario were identified as *Filaroides mustelarum* by W. M. Woodworth.

Nematodes from the frontal sinuses of Mustelidae have been known since 1842 when Leuckart (Zoologische Bruchstücke III, p. 43) described *Spiroptera nasicola*. This species was later erroneously synonymized with *Filaroides mustelarum*, a worm which is found in cysts in the lungs of mustelids. For years these poorly described organisms were confused and *F. mustelarum* was considered as inhabiting both the lungs and the frontal sinuses. Petrow (Sbornik Rabot. Gelm. Posv. Skrjabin., pp. 138–149, 1927) finally pointed out the discrepancies in this synonomy and redescribed the two species as *Skrjabingylus nasicola* (Leuckart, 1842) from the frontal sinuses and *Filaroides bronchialis* (Werner, 1782) from cysts in the lung.

Hill's description of *Skrjabingylus chitwoodorum* was the first report of this genus from North America but it is more than probable that parasites from the frontal sinuses previously recorded on this continent as *Filaroides mustelarum* are of the genus *Skrjabingylus*, possibly of the species *chitwoodorum*. Such records are Miller's (above) and Hanson's (U. S. D. A. circ. Bi 1235, 7 pp., 1932).—Frans C. Goble, *Wildlife Research Center, New York State Conservation Department, Delmar, New York.*

HYLONYCTERIS UNDERWOODI IN MEXICO

The genus *Hylonycteris* was described in 1903 by Oldfield Thomas (Ann. Mag. Nat. Hist., ser. 7, vol. 11, p. 286, 1903) from a specimen taken at Rancho Redondo, Tarbaca, Costa Rica, by C. F. Underwood, for whom it was named. Since then no further specimens are recorded nor has it been represented in any American museum. It is therefore worth reporting that in late December 1940, Dr. George Pournelle, of the University of Florida, while collecting mammals for the Museum of Comparative Zoology, obtained six specimens from a cave or mine tunnel at Metlac, Veracruz, Mexico. The uniformly dark-gray color above and below and the small size (forearm 33 mm) distinguish it externally, while the lack of lower incisors and the uninflated pterygoids are generic characters. This locality makes thus a wide extension of the known range.—Glover M. Allen, *Museum of Comparative Zoology, Cambridge, Mass.*

THE CANADA PORCUPINE IN SOUTHERN WISCONSIN

One of my sons informed me on January 10, 1934, that he had seen a Porcupine in the woods adjoining the University Pharmaceutical Gardens, near Madison. I went to the locality on the 13th. Scats were found under a Norway spruce and bark had been gnawed from the trunk near the top of the tree. After some search, an apparently adult Porcupine (*Erethizon dorsatum dorsatum*) was found in a large oak. Much bark had been removed from the upper surfaces of the higher branches. There will remain always serious doubt that the animal arrived at Madison without human assistance.

It is a logical assumption that the Porcupine once occupied all the timbered areas of

Wisconsin, with the possible exception of the oak openings; however, it is difficult to find references for the southern portion of the state specific as to date and locality. I. A. Lapham (Trans. Wis. State Agr. Soc., vol. 2, 1853, p. 340) states briefly: "Porcupine. Lake of the Hills, Sauk Co." It might be inferred that the species was unknown for the Milwaukee region where he resided. W. H. Canfield ("Outline Sketches of Sauk County. Third Sketch," Published in 1870) mentions that the "Hedgehog" was "more common when the country was new." Recently the following information was found in the Baraboo (Sauk County) *Republic* for Feb. 20, 1867: "Porcupines are said to be unusually plenty in some parts of the woods this winter. They commit considerable havoc among the young trees, especially the maples, which they strip of their bark from the ground to the extremist tips of their branches." The Porcupine occurred also in Richland County. One of the pioneers mentions it as one of the mammals to be found in 1855, when the village of Woodstock was laid out (Richland Center *Observer*, Jan. 17, 1878 [1]). It is of interest that the species persisted until at least 1882. Among the birds and mammals listed for a side hunt, the porcupine was down for 50 points (Richland Center *Republican* and *Observer*, Nov. 23, 1882 [8]).—A. W. Schorger, *168 North Prospect Avenue, Madison, Wisconsin.*

ENCEPHALITIS (?) IN RED FOX IN SOUTHWESTERN OHIO

On April 22, 1940, I stopped at a farm near Afton, Clermont County, Ohio to observe a captive female red fox (*Vulpes fulva*). Apparently a native animal from the surrounding territory, it was easily taken captive by a farm-hand 3 days before while it stood quietly in the doorway of the cattle barn. Surprisingly enough, the vixen made no attempt to attack when captured. However, when a collar and leash were placed on the mammal she bit her captor several times.

When examined the fox was noticeably lethargic, but only to a slight degree; her eyes, nose, and general physical condition gave little indication of a diseased state. Her appetite was normal and the stools were not soft and/or mucoid.

On the following Friday, April 26, 1940, the fox showed symptoms of flaccid paralysis and morbidity. Periodically she passed into acute convulsions. Her right eye was swollen completely shut; the left was clear. Her capacity for sight and smell was limited. A clear liquid dripped from the nose. The faeces were liquid and diarrhoetic. She would eat food only when it was placed directly before her muzzle. Even when the strong-smelling entrails of a partially decomposed chicken were placed more than three inches from her nose the morbid animal would grope feebly in an attempt to locate the viands.

The next day, the fox died following a stage of hyperexcitability and violent convulsions. When the brain was examined by the Ohio State Board of Health the diagnosis for rabies was negative.

The above symptoms and decision of the Health Board would seem to indicate that this fox may have been afflicted with encephalitis. Unfortunately, no attempt was made to examine the vascular endothelial cells or the tissues of the central nervous system. The nearest commercial fox ranch from which the stricken animal might have contracted the disease is 30 miles from Afton, Ohio.—Hubert Bezdek, *Ohio Division of Conservation, Batavia, Ohio.*

DISLIKE OF WATER BY THE CALIFORNIA JACK RABBIT

There are many records of various mammals entering water with or without provocation, but a California Jack Rabbit (*Lepus californicus californicus*), cornered by me on June 27, 1940, on a small peninsula at the state refuge near Los Banos, California, apparently did not want to enter the water under any circumstance. There was a small, narrow neck of dry ground running out into a shallow pond and, on going out there to observe ducks in the lake, I flushed a jack rabbit that immediately ran to the far end. I slowly approached the rabbit and it began to run back and forth, but did not enter the shallow water through which it could easily have waded to safety. Finally, when I was almost upon it it darted by me

so close that I could have touched it had I been quick enough.—ALBERT C. HAWBECKER, *Watsonville, California.*

SWIMMING ABILITY OF TWO SMALL MAMMALS

A knowledge of the swimming ability of mammals is important in distributional studies, especially among the species of smaller mammals. If a mammal voluntarily enters water, how far can it swim? Also, how wide must a stream be before it constitutes a natural barrier?

In the summer of 1941 I observed the swimming ability of two mammals that ordinarily are not seen in the water, namely, a bridled weasel and a small pocket mouse.

Bridled weasel (*Mustela frenata*).—About 10:30 a.m., on July 14, when encamped on the bank of the Rio Ramos, a small turbulent stream about 20 km northwest of Montemorelos, Nuevo Leon, Mexico, two companions and I saw an adult male weasel approach the stream not more than 30 feet from us, enter the water, and start swimming toward the opposite bank. The river at this place was approximately 40 feet wide and the water, although relatively shallow, was flowing rapidly. The weasel swam much as does a dog; the head was held high, the body was nearly submerged (only the hairs on the back were visible), and the tail streamed out behind.

This weasel entered the water voluntarily, and apparently it had deliberately contemplated crossing the stream long before it reached the water, as it had crossed an open, gravelly area more than 100 feet in width interposed between the stream and the nearest vegetative cover.

Seemingly this weasel could easily have negotiated a stream twice the width of the Rio Romas. Probably, therefore, most of the streams in the southwestern United States and in Mexico could be crossed by weasels without difficulty in most seasons.

Pocket Mouse (*Perognathus merriami*).—A group of us capturing mice the night of July 26, 2 miles south of Paisano, Presidio County, Texas, by "spotting" them with lights, saw a Merriam pocket mouse enter a puddle of water about 10 feet in diameter and swim with ease for a distance of approximately 4 feet before it was captured. In this instance the mouse emerged from the brush beside the road and seemingly entered the water voluntarily, as it was not being pursued. It swam relatively high in the water.

Narrow permanent streams probably do not constitute physical barriers to the movements of this species of pocket mouse. But, as in the case of the weasel, we do not know how wide a body of water mice of this species would attempt to cross voluntarily. Perhaps a stream as wide as 20 or 30 feet does not constitute a serious barrier to their movements.—WILLIAM B. DAVIS, *Department of Fish and Game, College Station, Texas.*

REVIEWS

Degerbøl, Magnus. MAMMALIA, being part 65 of the Zoology of the Faroes, published at the expense of the Carlsberg Fund, pp. 1–132, 17 figs., Copenhagen, 1940.

Five species of pinnipeds, 18 of cetaceans, and 3 of land mammals are discussed. The grey seal (*Halichoerus grypus*) is still fairly common; the harbor seal, once common, became practically extinct as a breeding species nearly 100 years ago; the other 3 species have been only casual visitors. The original whaling records were studied and the data summarized on numbers, seasonal occurrence, proportion of sexes, relative ages, measurements, contents of stomachs, and on some other features of natural history. More than half of the paper is devoted to the Cetacea and the important information there given will have to be consulted by any student who thoroughly familiarizes himself with Atlantic cetaceans.

The Norway rat, thought to have been introduced in 1768, occurs on several of the islands, although only 2 specimens were available to Degerbøl. The house mouse may have been on the islands for 1000 years and the four kinds there are: (1) *Mus musculus mykinessiensis* new subspecies, (2) *Mus musculus faeroensis* Eagle Clarke, (3) mice intermediate toward *M. m. musculus* from Thorshavn, and (4) mice from Fuglø resembling *M. m. musculus* in most features. Differences in color, size, and in shape of skull well differentiate *mykinessiensis* and *faeroensis* from one another and other *Mus*. Individual variation does not bridge the differences. The mice furnish an example of genetic variation, with the aid of geographic isolation, resulting in differentiates of systematic worth within a relatively short time.

As regards the length of time involved for considerable morphological change to occur in a species, a shorter period than in the case of *Mus* and also one of known length, is recorded for the progeny, on the Faroes, of 3 or possibly 4 hares, *Lepus timidus timidus*, introduced in 1854 or 1855 from Kragerø, southern Norway. In the first years on the Faroes the hares were pure white in winter like the parent stock. About 20 years later approximately half the animals were white; 30 years after the introduction only a fourth were white and in 1890 only 5 to 6 percent were white. The hares, in winter, now are bluish-gray on the upper parts; the ears are grayish brown and the underparts are white, pure white only in the middle of the underparts. The hares on the Faroes further differ from the parent stock in shortness of tibia, hind foot, and skull, and in some other features mostly having to do with smaller size. One of these other features is shortness of cheek teeth. Degerbøl advances evidence, but hardly proof, that soft food causes short teeth and tough food long teeth. He regards short teeth as a "phenotypical," as opposed to a "genotypical," feature, recognizes the possibility that some other features may be of the same nature, and therefore feels that "perhaps the best method of cataloguing the variation in such a case would be not to use the term subspecies, which implies a genetical change, but for instance the more neutral term *forma* or *forma geographica: Lepus timidus* forma *seclusus*" (p. 64).

To Degerbøl, then, as to some other continental vertebrate zoologists, "geographic form" pertains to a category different from subspecies. American students often use the two terms interchangeably but probably would do better to be more precise in their terminology. The account of the hare of the Faroes is initiated by "*Lepus timidus seclusus* var. nov." By inference, then, to Degerbøl variety is synonymous with geographic form. This is contrary to accepted usage of the terms among modern American students of vertebrates, who employ variety to denote a variation, assumedly of genetic basis, such as may distinguish siblings in a litter of *Vulpes fulva* where some are red and others silver. These variations, varieties, no longer are accorded recognition in trinary nomenclature but instead only by description. Probably Degerbøl did not intend to make "variety" synonymous with "form", in which event he should have been more precise in his use of the term variety.

The paper is especially important because it records in definite fashion modifications in color and in bodily structure that have occurred in a wild free-living stock of *Lepus* in only 85 years.

Of the change in color, one observer quoted by Degerbøl points out that the bluish-gray winter coat of *Lepus* "agrees entirely with that of the stone screes in which they live, and thus affords a much better protection than the purely white coat, which in addition rendered it very easy, when there was no snow, to detect it a long way off." Just how much less snow there is on the Faroes, in the middle of the warm Gulf Stream, than at Kragerø, Norway, is not stated. Neither are we told what the enemies of *Lepus* are on the Faroes. How much natural selection may have had to do with the change from a white to a bluish-gray winter coat is therefore not clear. Isolation, of course, is involved. Hares live on 10 of the islands but all specimens used by Degerbøl were from one island. If adequate material in the Faroes could be obtained from several islands having the same climate, an idea might be gained as to the effect of climate on speciation, versus the effect of isolation. Ordinarily for a zoological differentiate confined to an island, it is impossible to measure separately the rôle of climate and isolation. Opportunity as good as that in the Faroes for doing this is so rarely available to zoologists who wish to study free-living mammals that when world conditions permit, a study there with material from more islands could profitably be undertaken.—E. Raymond Hall.

Coolidge, Harold Jefferson, Jr., The Indo-Chinese Forest Ox or Kouprey. Mem. Mus. Comp. Zool. vol. LIV, no. 6, pp. 421–531, 12 figs., 11 pls. Cambridge 1940. $3.50.

Since 1930 reports have come out of Indo-China of the existence of a species of wild cattle different from the two species known from southern Asia, namely, the gaur and the banteng. In 1937 it was described by Urbain as *Bos* (*Bibos*) *sauveli*. At that time a living specimen was brought to the zoological park of Vincennes, Paris. No study of the anatomical characters of this animal was possible until, in 1939, the Museum of Comparative Zoology at Harvard College, received the skin and skeleton of an adult bull, shot by Monsieur F. Edmond-Blanc, at Samrong, province of Krati, Cambodja. This specimen has now been studied in great detail by Coolidge.

The general pattern is much like that of the gaur. It has the white lower legs common to both species of *Bibos*, but lacks the white pygal patch of the banteng. In color it more nearly approaches the gaur although it is not quite so dark. But it is much darker than even the adult bull of the banteng. Its tail is longer than in *Bibos* reaching considerably beyond the heels.

The horns are weaker, more expanded, and with a wider sweep than in both the gaur and banteng. Their cores are strongly compressed dorso-ventrally, and have a distinct, prominent, posterior keel absent elsewhere. The horny sheath is more rugose at the root than in the related forms. Its texture is more fibrous, and, therefore, has a tendency to become frayed at the tip. The horns are not widely separated at the base and the prominent intercornual ridge found in *Bibos* is quite absent.

In the skull the occipital plane is triangular, much more so than in the gaur, not rounded as in the banteng. Other important skull characters are the narrow lachrymal, the small ethmoid vacuity, and the shape of the nasals which terminate in a median point, but are not shortened, as in the gaur and banteng; they are in touch with the posterior process of the premaxillary. The tooth row in the kouprey is shorter than in the gaur and banteng, the P^4 is compressed antero-posteriorly; the molars are more quadrate, and the M^3 is shorter.

By comparison of the kouprey with the living, and with the Tertiary and Pleistocene general of cattle, the author is led to the conclusion that the kouprey is a species more primitive than its nearest living relative, that it belongs to the group of recent cattle to which *Bos*, *Bibos*, *Poephagus*, and *Bison* belong, but that it has become differentiated from the main phylogenetic line previous to the branching off of these genera. A new genus *Novibos* is made for the kouprey.

The distributional area is not fully explored. It is estimated that about 1000 animals of this species exist at the present time. Let us hope that more specimens, including cows and calves, will be procured for further study.

A special chapter of the paper deals with the history of the discovery of the kouprey. There is also a discussion of the question whether the species is involved in the ancestry of the zebu; no definite conclusion is drawn however.

This is an elaborate paper with many measurements and comparative tables. It contains detailed comparisons with all the living and the important fossil types of cattle recently revised by Pilgrim and critically evaluates their affinities in many directions. There is a map and many text figures, as well as one colored and ten black and white plates illustrating the external, skeletal, and dental characters of the kouprey and the forms with which it is compared.—ERNST SCHWARZ.

Biological Symposia, edited by Jaques Cattell. (SPECIATION. DEFENSE MECHANISMS IN PLANTS AND ANIMALS. BIOLOGICAL BASIS OF SOCIAL PROBLEMS. REGENERATION.) vol. 2, pp. 1–270, 1941. The Jaques Cattell Press, Lancaster, Pa. $2.50.

Since the days of Darwin and the "Origin of Species" and even before that time, scientists in several branches of Natural History have been energetically trying to remove the shroud of mystery that surrounds evolution and speciation. The present volume has a section devoted to a discussion of this problem.

Papers included are by Carl L. Hubbs (fishes), Lee R. Dice (mammals), Ernst Mayr (birds), T. Dobshansky (Drosophila), and others.

All three of the papers first mentioned, of importance and interest to mammalogists, agree that speciation is a genetic process under the rigid control of the environment, but beyond that their concepts seem to have little in common. Hubbs gives considerable attention to hybridization and to the phenomenon of parallel evolution, concluding that "the very general and striking tendency toward parallel genetic variation, with environmental correlations, at least suggests that relatively few and relatively simple biochemical processes are usually involved in speciation" in fish. If I have interpreted the author correctly, Hubbs' concept of subspecies includes continuity of geographic or space relationship.

Mayr centers his attention largely on the thesis that subspecies may, and frequently do, give rise to species when geographical and geological factors favor discontinuous ranges. Continuity of geographic relationship assumes major importance in Mayr's concept of subspecies.

Not so with Dice; by him continuity of geographic position seemingly is regarded as of but little importance. This is summed up in his statements that "the subspecies is considered to be primarily an ecologic unit, rather than a unit of similar descent or of similar heredity," and "some subspecies are probably polyphyletic in origin." Variations studied by the reviewer seemingly are not to be explained by this concept. Just because a mouse from sand dune A *looks like* one from dune B, several miles distant, is not evidence sufficient to warrant referring them to the same subspecies when the intervening area is known to be occupied by a different subspecies. The mosaic pattern of distribution necessary to this concept of subspecies hardly seems tenable. The reviewer concurs heartily with the concept that variations in morphological characters and intensity of color may be correlated in *some instances* with ecologic conditions, but we must take cognizance of the fact that in many instances no such correlation exists. Isolation in itself may be a potent factor!

Geographic differentiation in some species of mammals does correlate fairly well with ecologic differentiation. But if the subspecies is no more than an ecologic unit how can the fact be explained that a single subspecies of small mammal occupies two or more ecologic types? I refer to such phenomena as the distribution of *Marmota flaviventer nosophora* in Idaho where this rodent occurs at high elevations in the Rock Mountains as well as in the semi-desert of the Great Basin. The marmots from these two extremes are not discernibly different. A similar instance is found in the distribution of *Cratogeomys merriami merriami* in Mexico. There the same subspecies occurs in the Valley of Mexico (semi-arid type) and in the higher mountain meadows at 10,500 feet elevation. Other instances of this phenomenon are not uncommon.

Conversely, how can this theory account for the fact that two subspecies occupy the same ecologic type, thus being exposed to the same environmental influences, as in the case of *Citellus townsendii idahoensis* and *C. t. vigilis* in southwestern Idaho where only 600 feet of river separate their ranges? And how can this theory explain the U-shaped chain of intergrading subspecies of this squirrel found there? How can it explain the high degree of subspeciation in mice and shrews encountered on the islands off the mainland of Washington and British Columbia where ecologic conditions are similar to those on the adjacent mainland?

It is such thought provoking contributions as these by Dice, Hubbs, and Mayr that may eventually lead to a clear understanding of species and subspecies. That we have not reached that goal is clearly evident from the diverse opinions held today.—WILLIAM B. DAVIS.

Edwards, Dorothy Lee. ALL ABOUT ELEPHANTS. E. P. Dutton and Co., New York. 1941. 88 pp., 36 photographs. $1.50.

Written in simple language and profusely illustrated with photographs of elephants in various situations, All About Elephants is intended primarily for children. Yet like most books designed for the education of the youthful mind, the present volume has much to offer the adult. Miss Edwards has gathered many items concerning the life history of elephants. All is stated as fact. If there is fiction or erroneous information contained therein the reader must know his elephants to discover it. Since Miss Edwards has had access to the records and materials contained in the American Museum of Natural History and to the suggestions and criticisms of the scientific staff of that institution, one may assume that the information in this book was examined critically before it was included.—EMMET T. HOOPER.

RECENT LITERATURE

(Conducted by Gerrit S. Miller, Jr., Remington Kellogg, and Emma M. Charters)

ADLOFF, P. Ergänzende Bemerkungen zur Beurteilung des Gebisses von Sinanthropus Pekinensis. Anat. Anz., Berlin, vol. 91, no. 9/11, pp. 160–175. April 16, 1941.

ALLEN, GLOVER M. Our rarer mammals. Audubon Mag., Harrisburg, vol. 43, no. 2, pp. 151–160, illus. March–April, 1941.

ANONYMOUS. The wild-life probem of the National Park System. Science, Lancaster, n. s., vol. 74, no. 1926, p. 540. November 27, 1931.

——— A short list of wildlife publications with special regard to Texas. Game, Fish and Oyster Commission, Austin, Bull. no. 14, 31 pp. October, 1938. (Revised June, 1939.)

——— New hope for the Biological Survey. Publ. National Anti-Steel-Trap League, Inc., Washington, D. C., 31 pp. November, 1939. (Wildlife destruction.)

——— In memoriam. Witmer Stone (1866–1939). Proc. Acad. Nat. Sci. Philadelphia, vol. 91, pp. 415–418. 1939.

——— Publications from the Yale Laboratories of Primate Biology, Inc. 1925–1939. School of Medicine, Yale Univ., New Haven, 14 pp. 1940.

——— [South American "paca"]. Pennsylvania Game News, Allentown, vol. 11, no. 10, p. 19, photo. January, 1940. (A paca killed October 28, 1939, in a chicken-coop at Nicholson, Wyoming County.)

——— Information for the guidance of fieldmen and cooperators of the Fish and Wildlife Service engaged in the control of predatory animals and injurious rodents. U. S. Dept. Interior, Fish and Wildlife Service, Wildlife Cir. 5, pp. 1–7. July, 1940.

ANONYMOUS. Regulations relating to migratory birds and certain game mammals: 1940. U. S. Dept. Interior, Fish and Wildlife Service, Wildlife Cir. 9, Washington, D. C., 13 pp. August, 1940.

——— Whale marking. Nature, London, vol. 147, no. 3724, p. 324. March 15, 1941.

——— Mammals and man. Nature, London, vol. 147, no. 3724, p. 325. March 15, 1941.

——— The mountain sheep survey. Wyoming Wild Life, Cheyenne, vol. 6, no. 3, illus. March, 1941.

——— Michigan otter still a puzzle. Michigan Conservation, Lansing, vol. 10, no. 5, p. 5. April, 1941.

BARKALOW, FREDERICK S., JR. Game heads—care and preservation in the field. Alabama Game and Fish News, Montgomery, 2 pp. (not numbered). December, 1939.

——— Industrious beaver is returning to this state. Alabama Game and Fish News, Montgomery, pp. 5–7, fig. 1. September, 1940.

BARTLETT, ROBERT A. Greenland expedition of 1940. Explor. and Field-work Smithsonian Inst. 1940, publ. no. 3631, pp. 47–52, illus. April 3, 1941.

BARTON, D. R. The way of a fossil hunter. Nat. Hist., New York, vol. 47, no. 3, pp. 172–176, photo. March, 1941. (Walter Granger.)

——— The evolution of an evolutionist [William King Gregory]. Though indifferent to nature as a boy, he grew up to become her ardent and untiring missionary as well as one of her most penetrating interpreters. Nat. Hist., New York, vol. 47, no. 4, pp. 234–237, photo. April, 1941.

BELOSLUDOV, B. A., and V. S. BASHANAV. A new genus and species of rodent from the Central Kazakhstan (U. S. S. R.). Uchenyie Zapiski Kazakhskogo Gosudarstvennogo Universiteta, Alma-Ata, vol. 1, Biol., pp. 81–86, 2 figs. February 5, 1939. (New: *Selevinia*, *S. betpakdalaensis*.)

BERNARD, HARRY. An albino porcupine (*Erithizon dorsatum*). Canadian Field-Nat., Ottawa, vol. 55, no. 1, p. 14, fig. January, 1941.

BLACKMAN, THOMAS M. Rarest seal. Nat. Hist., New York, vol. 47, no. 3, pp. 138–139, illus. March, 1941. (*Monachus schauinslandi*.)

BLACKWELDER, RICHARD E. The gender of scientific names in zoology. Jour. Washington Acad. Sci., Menasha, vol. 31, no. 4, pp. 135–140, tables 2. April 15, 1941.

BLANDAU, RICHARD J., JOHN L. BOLING, and WILLIAM C. YOUNG. The length of heat in the albino rat as determined by the copulatory response. Anat. Record, Philadelphia, vol. 79, no. 4, pp. 453–463, 1 fig. April 25, 1941.

BRADT, G. W. Beaver management pays. Michigan Conservation, Lansing, vol. 10, no. 5, pp. 4, 5. April, 1941.

BRITTON, S. W. Form and function in the sloth. Quart. Rev. Biol., Baltimore, vol. 16, no. 1, pp. 13–34, figs. 13. March, 1941.

BROWN, W. L. Collecting habitat group material in the Canadian Rockies. Explor. and Field-work Smithsonian Inst. 1940, publ. no. 3631, pp. 31–34, illus. April 3, 1941.

BRUCE, JEAN A. Time and order of appearance of ossification centers and their development in the skull of the rabbit. Amer. Jour. Anat., Philadelphia, vol. 68, no. 1, pp. 41–67. January 15, 1941.

BUGHER, JOHN C., JORGE BOSHELL-MANRIQUE, MANUEL ROCA-GARCIA, and RAYMOND M. GILMORE. The susceptibility to yellow fever of the vertebrates of eastern Colombia. 1. Marsupialia. Amer. Jour. Tropical Med., Baltimore, vol. 21, no. 2, pp. 309–333, fig. 1. March, 1941.

BURTON, R. W. The Indian wild dog. Jour. Bombay Nat. Hist. Soc., Bombay, vol. 42, no. 2, pp. 436–437. April, 1941.

BYRNE, FRANK. Notes on the evolution of the mammal-like reptiles. Trans. Kansas Acad. Sci. Topeka, vol. 43, pp. 291–296, fig. 1. 1940.

CABALLERO, EDUARDO. Una excursión científica a la Isla de Guadalupe, Baja California. Memorias de la Academia "Antonio Alzate", Mexico, vol. 55, pp. 117–125, figs. 4. November 9, 1936.

CABRERA, ÁNGEL. Notas sobre carnívoros sudamericanos. Inst. Mus. Univ. Nac. La Plata, Notas del Museo de La Plata, Buenos Aires, vol. 5, Zool., no. 29, 22 pp. March 25, 1940. (New: *Atelocynus* for *Canis microtis* Sclater; *Grammogale* for *Mustela africana* Desmarest; *Oreailurus* for *Felis jacobita* Cornalia. Republished by Cabrera and Yepes, Mamíferos Sud-Americanos, pp. 130, 150, 160, received in Washington, June, 1940.)

CALHOUN, JOHN B. Distribution and food habits of mammals in the vicinity of the Reelfoot Lake Biological Station. Pt. 1. Jour. Tennessee Acad. Sci., Nashville, vol. 16, no. 1, pp. 177–185. January, 1941.

——— Distribution and food habits of mammals in the vicinity of the Reelfoot Lake Biological Station. Pt. 2. Jour. Tennessee Acad. Sci., Nashville, vol. 16, no. 2, pp. 207–225, figs. 2. April, 1941.

CARPENTER, C. R. The menstrual cycle and body temperature in two gibbons (*Hylobates lar*). Anat. Record, Philadelphia, vol. 79, no. 3 and suppl. no. 2, pp. 291–296. March 25, 1941.

CARPENTER, R. R. M. The quest of the silver ram. Frontiers, Philadelphia, vol. 5, no. 3, pp. 67–74, illus. February, 1941.

CATTELL, PSYCHE. Intelligence of infants and its measurement. Trans. New York Acad. Sci., New York, ser. 2, vol. 3, no. 6, pp. 162–171. April, 1941.

CHEVERLANGE, ELIE. The manlike apes of jungle and mountain. National Geographic Magazine, Washington, D. C., vol. 78, no. 2, pp. 221–228, pls. 1–8. August, 1940. (10 portraits in color from paintings.)

CLARK, JOHN. An anaptomorphid primate from the Oligocene of Montana. Jour. Palaeont., Menasha, vol. 15, no. 5, pp. 562–563, fig. 1. September, 1941. (New: *Macrotarsius*, *M. montanus*.)

COOK, HAROLD J., and JOSEPH T. GREGORY. *Mesogaulus praecursor*, a new rodent from the Miocene of Nebraska. Jour. Palaeont., Menasha, vol. 15, no. 5, pp. 549–552, figs. 2. September, 1941. (New: *Mesogaulus praecursor*.)

COOKE, H. B. S. A preliminary account of the Wonderwerk Cave, Kuruman District. Sect. 2: The fossil remains. S. African Jour. Sci., Johannesburg, vol. 37, pp. 303–312, figs. 2–5. February, 1941.

CORBIN, KENDALL B., and FRANK HARRISON. The sensory innervation of the spinal accessory and tongue musculature in the rhesus monkey. Brain, London, pt. 2, vol. 62, pp. 191–197. June, 1939.

COX, W. T. The fight for the woodland caribou. American Forests, Washington, D. C., vol. 47, no. 2, pp. 55–57, 93–94, illus. February, 1941.

CRABB, EDWARD D., and MARGARET A. KELSALL. Taxonomic significance of the cecum in gnawing mammals. Jour. Colorado-Wyoming Acad. Sci., Denver, vol. 3, no. 1, pp. 44–45. April, 1941.

CRABB, WILFRED D. Civets are rat killers. Sci. Reporter, Ames, vol. 2, no. 1, pp. 12–13. January, 1941. (Little spotted skunk.)

CRESSMAN, L. S., and W. S. LAUGHLIN. A probable association of mammoth and artifacts in the Willamette Valley, Oregon. American Antiquity, Menasha, vol. 6, no. 4, pp. 339–342, pls. 2. April, 1941.

CREW, F. A. E., and CHARLOTTE AUERBACH. "Pigtail," a hereditary tail abnormality in the house mouse, *Mus musculus*. Jour. Genetics, London, vol. 41, nos. 2 and 3, pp. 267–274, figs. 2, pls. 7–8. January 23, 1941.

DALE, BONNYCASTLE, JR. Moose babies. Field and Stream, New York, vol. 45, no. 12, pp. 28–29, 99, illus. April, 1941.

DALKE, PAUL D., and PALMER R. SIME. Food habits of the eastern and New England cottontails. Jour. Wildlife Management, Menasha, vol. 5, no. 2, pp. 216–228. April, 1941.

DAMMERMAN, K. W. The orang utan. Dutch East Indies, Departement van landbouw, nijverheid en handel (Nature Protection in the Netherlands Indies), Dept. Econ. Affairs, Batavia, pp. 1–6, illus. 1938.

DAMMERMAN, K. W. The pangolin of Java. Dutch East Indies, Departement van landbouw, nijverheid en handel (Nature Protection in the Netherlands Indies), Dept. Econ. Affairs, Batavia, pp. 36–38, illus. 1938.

DAVIS, WM. B. Mammals compose more than 92 percent of food of the barn owl in Texas. Texas Game, Fish and Oyster Comm., Austin, Monthly Bull., vol. 3, no. 2, p. 6. January, 1941.

DAWSON, ALDEN B. The development and morphology of the corpus luteum of the cat. Anat. Record, Philadelphia, vol. 79, no. 2 and suppl. no. 1, pp. 155–177, pls. 4. February, 1941.

DE GARIS, CHARLES F. The aortic arch in primates. Amer. Jour. Phys. Anthrop., Philadelphia, vol. 28, no. 1, pp. 41–74, figs. 2. March 31, 1941.

DEGERBØL, MAGNUS. Mammalia. Zoology of the Faroes, Copenhagen, pp. 1–132, figs. 17. 1940.

DENMAN, A. V. White sheep and grizzly bear. Alaska Sportsman, Ketchikan, vol. 7, no. 1, pp. 12–13, 30–32. January, 1941.

DIDUSCH, JOSEPH S. Primitive man. Bull. Nat. Hist. Soc. Maryland, Baltimore, vol. 11, no. 3, pp. 1–46, figs. 7. January–February, 1941.

EHRENBERG, KURT. *Ursus Deningeri* v. Reich. und *Ursus spelaeus* Rosenm. Sitz. der Math.-naturw. Kl., Akad. Wiss. Wien, Akad. Anz. no. 10, 4 pp. April 26, 1928.

EISEN, ALBERT. En mångsidig forskare ur tiden. Fauna och Flora, Uppsala, Häft 2, pp. 61–68, photo. 1941. (August Gustaf Eisen, born August 2, 1847, died October 29, 1940, at New York.)

ELLERMAN, J. R. The families and genera of living rodents. With a list of named forms (1758–1936) by R. W. Hayman and G. W. C. Holt. Publ. Brit. Mus. (Nat. Hist.), London, vol. 1 (Rodents other than Muridae), pp. xxvi + 689, figs. 189, June 8, 1940; vol. 2, (Family Muridae), pp. xii + 690, figs. 50, March 21, 1941.

ENDERS, ROBERT K., and JAMES R. LEEKLEY. Cyclic changes in the vulva of the marten (*Martes americana*). Anat. Record, Philadelphia, vol. 79, no. 1, pp. 1–11, pls. 2. January 25, 1941.

EVERETT, ROBERTA. Animal drawings No. 2. Bull. New York Zool. Soc., vol. 44, no. 1, pls. 7. January–February, 1941.

FEKETE, ELIZABETH, C. C. LITTLE, and A. M. CLOUDMAN. Some effects of the gene W^v (dominant spotting) in mice. Proc. Nat. Acad. Sci., Washington, D. C., vol. 27, no. 2, pp. 114–117. February, 1941.

FELL, H. BARRACLOUGH. Animal behavior during air-raids. Science, Lancaster, n. s., vol. 93, no. 2403, pp. 61–62. January 17, 1941.

FISCHER, GUILLERMO MANN. Contribucion a la anatomia de los octodontidos. Bol. Mus. Nac. Hist. Nat., Santiago de Chile, vol. 18, pp. 103–124, figs. 29. 1940.

FISHER, JAMES. Animals and birds in air raids. Field, London, vol. 177, no. 4594, p. 60. January 11, 1941.

FLEAY, DAVID. Platypuses transferred to Kangaroo Island. Victorian Nat., Melbourne, vol. 57, no. 12, pp. 214–215. April, 1941.

FLEMING, LAUNCELOT, COLIN BERTRAM, and BRIAN ROBERTS. Three Antarctic years. The British Graham Land expedition of 1934–1937. Canadian Geogr. Jour., Ottawa, vol. 22, no. 1, pp. 2–39, illus. January, 1941. (Good photographs of crabeater seals and sea elephants.)

FOOKS, H. A. A pale colour form of the panther. Jour. Bombay Nat. Hist. Soc., Bombay, vol. 42, no. 2, pp. 435–436, photo. April, 1941.

FORBES, THOMAS, R., and ROBERT K. ENDERS. Observations on corpora lutea in the ovaries of muskrats collected during the winter. Maryland Conservationist, Baltimore, vol. 17, no. 3, pp. 1–2, illus. 1940.

FRIES, M. E. Die Form rezenter und diluvialer Rentiergeweihe als Beweis der geographischen Herkunft der europäischen Rentiere. Zoogeographica, Jena, vol. 4, no. 1, pp. 1–17, pls. 6. March, 1941.

GAZIN, C. LEWIS. Trailing extinct animals in central Utah and the Bridger Basin of Wyoming. Explor. and Field-work Smithsonian Inst. 1940, publ, no. 3631, pp. 5–8, illus. April 3, 1941.

——— Paleocene mammals from the Denver Basin, Colorado. Jour. Washington Acad. Sci., Menasha, vol. 31, no. 7, pp. 289–295, figs. 2. July 15, 1941. (New: *Baioconodon, B. denverensis.*)

GERSHENSON, S., and V. POLEVOI. Mating system in a natural population of the common hamster (*Cricetus cricetus* L.). Comptes Rendus (Doklady) Acad. Sci. USSR, Moscou, n. s., vol. 30, no. 1, pp. 64–65. 1941.

GESELL, ARNOLD. The biography of a wolf-child. Harper's Mag., New York, vol. 182, no. 1088, pp. 183–193 and photograph, 4th page of "Personal and otherwise." January, 1941.

GIBBON, HELEN. Leopard spotting and color alteration in that recently established breed of horses, the Colorado rangers. Jour. Colorado-Wyoming Acad. Sci., Denver, vol. 3, no. 1, p. 48. April, 1941.

GILLMAN, JOSEPH. Toe sucking in the baboon. S. African Jour. Sci., Johannesburg, vol. 37, p. 250. February, 1941.

GILMORE, RAYMOND M. Zoology. [Classification of South American marsupial genera.] Amer. Jour. Tropical Med., Baltimore, vol. 21, no. 2, pp. 314–319. March, 1941.

GLUCKMAN, JOHN. Effects of the implantation of the male human anterior pituitary gland on endocrine glands of the female immature albino rat. S. African Jour. Sci., Johannesburg, vol. 37, pp. 253–255. February, 1941.

GOODWIN, G. G. A new *Peromyscus* from western Honduras. Amer. Mus. Novitates, New York, no. 1121, p. 1. June 9, 1941. (New: *Peromyscus hondurensis.*)

GOWANLOCH, JAMES NELSON. Louisiana's picturesque wild life names. Louisiana Conservation Review, Dept. Conservation, New Orleans, vol. 10, no. 1, pp. 30–34, 37, illus. 1941.

GREEN, E. L., and C. W. MCNUTT. Bifurcated xiphisternum and its relationship with short ears in the house mouse. Jour. Heredity, Baltimore, vol. 32, no. 3, pp. 94–96, fig. 1. March, 1941.

GREEN, R. G. Chastek paralysis from fish diets. Amer. Fur Breeder, Duluth, vol. 13, no. 9, p. 20. March, 1941.

GREGORY, JOSEPH T. The rostrum of *Felsinotherium ossivalense*. State of Florida, Dept. Conservation, Geol. Surv., Geol. Bull. no. 22, pp. 29–47, figs. 2, pls. 2. 1941.

GRIFFIN, DONALD R., and ROBERT GALAMBOS. The sensory basis of obstacle avoidance by flying bats. Jour. Exper. Zool., Philadelphia, vol. 86, no. 3, pp. 481–506. April 5, 1941.

HALDANE, J. B. S. Blood groups of anthropoids. Nature, London, vol. 146, no. 3707, p. 652. November 16, 1940.

HALL, E. RAYMOND. Freak antlers of mule deer. California Fish and Game, San Francisco, vol. 27, no. 1, pp. 38–39, figs. 19–20. January, 1941.

HELLBAUM, ARTHUR A., and ROY O. GREEP. Qualitative changes in the gonadotropic complex of the rat pituitary following removal of the testes. Amer. Jour. Anat., Philadelphia, vol. 67, no. 2, pp. 287–304. September 16, 1940.

HEPTNER, V. G. Fauna der Gerbiilidae [sic] (Mammalia, Glires) Persiens und die tiergeographischen Eigenheiten der Kleinasiatisch-Irano-Afganischen Länder. Nouv. Mém. Soc. Nat., Moscou, vol. 20, pp. 3–71, figs. 1–69, maps 4. 1940. (With German summary.)

——— Some rare and interesting Carnivora and Ungulata of the Moscou Zoological Gardens. Proc. Moscou Zool. Park, vol. 1, pp. 45–49. 1940.

——— Taxonomic and zoogeographical interrelations of some Asiatic and North-American ground-squirrels. Zoogeographica, Jena, vol. 4, no. 1, pp. 21–27. March, 1941.

HESCHELER, K. Ein neuer Schädelfund vom Moschusochsen aus dem Gebiete des diluvialen Reussgletschers. Eclogae Geol. Helvetiae, Basel, vol. 32, no. 2, p. 184. April 15, 1940.

HESCHELER, KARL, and JAKOB RÜEGER. Die Wirbeltierreste aus den Pfahlbauten des Baldeggersees nach den Grabungen von 1938 und 1939. Vierteljahrsschr. Nat. Gesell., Zürich, vol. 85, nos. 3–4, pp. 59–70. December 31, 1940.

HIGHBY, PAUL R. Managing our muskrat resource. Conserv. Volunteer, St. Paul, vol. 2, no. 7, pp. 17–20. April, 1941.

HINDMAN, FLINT. Water holes with roots. Fauna, Philadelphia, vol. 2, no. 4, pp. 71–74, illus. December, 1940. (Mountain sheep and prickly poppy.)

HITCHCOCK, HAROLD B. *Myotis subulatus leibii* and other bats hibernating in Ontario and Quebec. Canadian Field-Nat., Ottawa, vol. 55, no. 3, p. 46. March 27, 1941.

HOLMES, ARTHUR D., FRANCIS TRIPP, FRANK G. ASHBROOK, and CHARLES E. KELLOGG. A study of vitamin A in the nutrition of foxes. U. S. Dept. Interior, Fish and Wildlife Service, Wildlife Research Bull. 3, pp. 1–15, tab. 8. 1941.

HOOGERWERF, A. Among rhino and Javanese wild ox (banteng) in the Oedjoeng Koelon Game Reserve. Dutch East Indies, Department van landbouw, nijverheid en handel (Nature Protection in the Netherlands Indies), Dept. Econ. Affairs, Batavia, pp. 8–14, illus. 1938.

HOPWOOD, TINDELL A. Fossil mammals and Pleistocene correlation. Proc. Geol. Assoc., London, vol. 51, pt. 1, pp. 79–88. March 29, 1940.

HOUSSAY, B. A., F. S. SMYTH, V. G. FOGLIA, and A. B. HOUSSAY. Acción diabetógena de la hipófisis de diversos animales sobre los mamíferos. Rev. Soc. Argentina Biol., Buenos Aires, vol. 17, no. 1, pp. 5–25. April, 1941.

HOWARD, ALMA. "Rhino," an allele of hairless in the house mouse. Jour. Heredity, Washington, D. C., vol. 31, no. 11, pp. 466–470. November, 1940.

HOWITT, BEATRICE F., and WILLIAM VAN HERICK. Attempted adaptation of the virus of poliomyelitis to wild rodents. Proc. Soc. Exper. Biol. and Med., Utica, vol. 46, no. 3, pp. 431–435. March, 1941.

HUEY, LAURENCE M. A new *Perognathus arenarius* from near the U. S.-Mexican boundary in Lower California. Trans. San Diego Soc. Nat. Hist., vol. 9, no. 13, pp. 57–58. August 31, 1939. (New: *Perognathus arenarius mexicalis*.)

HUNTER, J. S., and DONALD H. FRY, JR. Trends in California's game kill 1935–1938. California Fish and Game, San Francisco, vol. 27, no. 1, pp. 13–28, figs. 17. January, 1941.

HÜRZELER, JOH. Säugetierfaunulae aus dem oberen Vindobonien der Nordwest-Schweiz. Eclogae Geol. Helvetiae, Basel, vol. 32, no. 2, pp. 193–203. April 15, 1940.

INGEN, BOTHA VAN. A brown form of the Himalayan black bear (*Selenarctos thibetanus*). Jour. Bombay Nat. Hist. Soc., Bombay, vol. 42, no. 2, p. 436. April, 1941.

INMAN, OTTILIE RUTH. Embryology of hereditary brachydactyly in the rabbit. Anat. Record, Philadelphia, vol. 79, no. 4, pp. 483–505, pls. 2. April 25, 1941.

INUKAI, TETSUO. A preliminary note on the ribbon seal, *Histriophoca fasciata* (Zimm.) Gill, from the waters of Saghalien. Jour. Faculty Sci., Hokkaido Imp. Univ., Sapporo, vol. 7, no. 3, pp. 299–303, figs. 2. November, 1940. (Distribution.)

IVERSEN, THOR. Hvor isbjørnen ferdes. Naturen, Bergen, årgang 65, no. 2, pp. 36–50, figs. 5. February, 1941. (Polar bears.)

JANSSEN, RAYMOND E. Stalking wild life through the mails. Nat. Notes, Peoria, vol. 7, no. 10, pp. 219–223. October, 1940.

KEEN, J. A., and C. S. GROBBELAAR. The comparative anatomy of the tympanic bulla and auditory ossicles, with a note suggesting their function. Trans. Roy. Soc. South Africa, Cape Town, vol. 28, pt. 4, pp. 307–329, figs. 78. 1941.

KEITH, ARTHUR. Hand of the Sterkfontein ape. Nature, London, vol. 147, no. 3718, p. 146. February 1, 1941.

KEITH, ARTHUR. Dr. Eugene Dubois (Obituary). Nature, London, vol. 147, no. 3729, pp. 473–474. April 19, 1941.

KEELAN, W. P. Village dogs hunting. Jour. Bombay Nat. Hist. Soc., Bombay, vol. 42, no. 2, pp. 437–438. April, 1941.

KELLOGG, CHAS. E. The Federal fur animal research program. Amer. Fur Breeder, Duluth, vol. 13, no. 8, pp. 22–24. February, 1941.

——— Silver fox pup values in relation to date of birth, age of vixens and other factors. U. S. Dept. Interior, Fish and Wildlife Service, Wildlife Circular 8, 15 pp., figs. 2. 1941.

KELLOGG, MARGARET P. The development of the periovarial sac in the white rat. Anat. Record, Philadelphia, vol. 79, no. 4, pp. 465–473. April 25, 1941.

KELWAY, PHYLLIS. Breeding harvest mice. Game and Gun and the Angler's Monthly, London, vol. 18, no. 185, pp. 63–65, illus. February, 1941.

——— The bombing squirrel. Game and Gun and the Angler's Monthly, London, vol. 18, no. 186, pp. 102–104, illus. March, 1941.

——— The wood mouse. Game and Gun and the Angler's Monthly, London, vol. 18, no. 188, pp. 181–183, illus. May, 1941.

KERSHAW, J. A. The platypus on Wilson's promontory. Victorian Nat., Melbourne, vol. 57, no. 11, pp. 194–195, pl. 20. March, 1941.

KINGSBURY, B. F. The development of the pharyngeal derivatives of the opossum (*Didelphys virginiana*), with special reference to the thymus. Amer. Jour. Anat., Philadelphia, vol. 67, no. 3, pp. 393–433, 5 pls. November 15, 1940.

KNIGHT, J. BROOKES. Are corrections to the original spelling of generic names advantageous? Amer. Jour. Sci., New Haven, vol. 239, no. 4, pp. 312–315. April, 1941. (Condemns the practice.)

KOLLER, P. C. The genetical and mechanical properties of the sex chromosomes. VII. *Apodemus sylvaticus* and *A. hebridensis*. Jour. Genetics, London, vol. 41, nos. 2 and 3, pp. 375–389, figs. 9. January 23, 1941.

KOLOSVARY, G. v. Über die initiativen Reaktionen der Klein-nagetiere (Rodentia). Teil 2. Folia Zoologica et Hydrobiologica, Riga, vol. 10, no. 2, pp. 381–382. September 5, 1940. (*Evotomys glareolus*, *Arvicola schermanni* [sic], *Pitymys subterraneus*.)

KORMOS, TH. Neue Beiträge zur Kenntnis der Gattung *Prospalax*. Állattani Közlemények, Budapest, vol. 34, fasc. 3–4, pp. 130–142, figs. 2. December 4, 1937. (*Spalax ehrenbergi*. Hungarian with German summary.)

KRAMER, FRANK M. Museum and microscopic technique. Dry preservation of museum specimens: a review, with introduction of simplified technique. Jour. Technical Methods and Bull. International Assoc. Med. Museums, Ann Arbor-Montreal, no. 18, pp. 42–50, figs. 5. 1938.

KRETZOI, M. VON. Alttertiäre Perissodactylen aus Ungarn. Ann. Mus. Nat. Hungarici, Pars Mineral., Geol. and Palaeont., Budapest, vol. 33, pp. 87–97, pl. 3. 1940.

LANE, CHARLES E. The ovary of the adult rat. Anat. Record, Philadelphia, vol. 78, no. 1, pp. 31–41. September 25, 1940.

LAWRENCE, BARBARA. Collections from the Philippine Islands. Mammals. Bull. Mus. Comp. Zool., Cambridge, vol. 86, no. 2, pp. 28–73. November, 1939. (New: *Haplonycteris*, *H. fischeri*, *Eonycteris spelaea glandifera*, *Rhinolophus philippinensis alleni*, *Hipposideros erigens*, *Suillotaxus* for *Mydaus marchei* Huet.)

LAWRENCE, PHILIP S. The sex ratio, fertility and ancestral longevity. Quart. Rev. Biol., Baltimore, vol. 16, no. 1, pp. 35–79. March, 1941.

LEONARD, A. BYRON, and ALICE E. LEONARD. The cellular proliferation associated with cysticercus infestations in the cottontail rabbit. Trans. Kansas Acad. Sci., Topeka, vol. 43, pp. 429–432, figs. 4. 1940.

LEY, WILLY. Will the wisent survive the war? Fauna, Philadelphia, vol. 2, no. 2, pp. 23–27, illus. June, 1940.

LIPPINCOTT, JOSEPH W. Animals outside the Zoo. Fauna, Philadelphia, vol. 3, no. 1, pp. 12–13, illus. March, 1941.

LOCHTE, THEODORE. Atlas der menschlichen und tierischen Haare. Leipzig, Verlag Dr. Paul Schops, pp. xi + 306, figs. 506. 1938.

LONGHURST, WILLIAM M., and JOHN E. CHATTIN. The burro deer, *Odocoileus hemionus eremicus*. California Fish and Game, San Francisco, vol. 27, no. 1, 12 pp., figs. 3. January, 1941.

LÖNNBERG, EINAR. Notes on some members of the genera *Lagothrix* and *Ateles*. Arkiv Zool., Stockholm, vol. 32 A, no. 25, pp. 14. July 18, 1940. (New: *Lagothrix puruensis*.)

LORENZO, G. DE, and G. D'ERASMO. Avanzi di elefante e di ippopotamo nella valle del Sele. Societa reale di Napoli, Rendiconto, Accad. Napoli, Sci. Fis. e matem., ser. 4, vol. 8 (year 77), p. 176. November 29, 1938.

MALAN, B. D. A preliminary account of the Wonderwerk Cave, Kuruman District. Sect. 1: Site and archaeology. S. African Jour. Sci., Johannesburg, vol. 37, pp. 300–303, fig. 1. February, 1941.

MANN, WILLIAM M., and LUCILE Q. MANN. Collecting live animals in Liberia. Explor. and Field-work Smithsonian Inst. 1940, publ. no. 3631, pp. 13–20, illus. April 3, 1941.

MÁRQUEZ, LUIS CUERVO. Especies extinguidas—Hallazgos fósiles en la Sabana de Bogotá. Rev. Acad. Colombiana Cienc. Exactas, Fis. y Nat. Corresp. de la Española, Bogotá, vol. 2, no. 5, pp. 38–42, figs. 23. January–March, 1938. (Proboscideans, equids.)

MARTINEZ, LIBORIO, and BERNARDO VILLA RAMIREZ. Contribucion al conocimiento de los murcielagos. III. Anales Inst. Biol., Mexico City, vol. 12, no. 1, pp. 401–419, figs. 3. 1941.

MARX, LORE, and J. T. BRADBURY. Correlation of ovarian histology and intersexuality of the genital apparatus, with special reference to apl-treated infantile rats. Anat. Record, Philadelphia, vol. 78, no. 1, pp. 79–103, 2 pls. September 25, 1940.

MATHIAK, HAROLD A. A key to hairs of the mammals of southern Michigan. Jour. Wildlife Management, Menasha, vol. 2, no. 4, pp. 251–268, figs. 38. October, 1938.

MATTHES, ERNST. A teoria vertebral do crânio desde Goethe até à actualidade. Arquivos do Museu Bocage, Lisboa, vol. 9, pp. 1–16. 1938.

——— Sôbre uma notável anomalia dentária no Hipopótamo. Arquivos do Museu Bocage, Lisboa, vol. 10, pp. 9–14, 4 figs. 1939.

——— Abnorme mandibularcanini bei Hippopotamus. Zeitschr. Anat. Entwicklungsgesch., Berlin, vol. 110, no. 2, pp. 181–211, figs. 28. 1939.

——— Dimensões, forma e posição dos caninos inferiores do hippopótamo. Rev. Faculade de Ciências da Univ. Coimbra, vol. 8, no. 1, pp. 1–26, figs. 3. 1939.

MCATEE, W. L. Gurdon Trumbull. The Auk, Cambridge, vol. 57, pp. 597–598., October, 1940.

MCCLURE, H. ELLIOTT. Zoological jottings. Animal signs. Nature Notes, Peoria, vol. 8, no. 1, pp. 9–12, figs. 2. January, 1941.

MCGREW, PAUL O. A new procyonid from the Miocene of Nebraska. Geol. Series Field Mus. Nat. Hist., Chicago, vol. 8, no. 5, pp. 33–36, figs. 12–13. September 20, 1941. (New: *Phlaocyon marslandensis*.)

——— A new Miocene lagomorph. Geol. Series Field Mus. Nat. Hist., Chicago, vol. 8, no. 6, pp. 37–41, fig. 14. September 20, 1941. (New: *Oreolagus nebrascensis*.)

MILLER, GERRIT S., JR. Man's biological outlook. Science, Lancaster, vol. 94, pp. 163–164. August 15, 1941. (The human combination of dominating primate type of social behavior with unique ingenuity in "implementing" it may prove to be racially lethal.)

MILLER, GERRIT S., JR., and HERBERT W. KRIEGER. Expedition to Samaná Province, Dominican Republic. Explor. and Field-work Smithsonian Inst. 1928, publ. no. 3011, pp. 43–54, figs. 12. 1929.

MORELLO, MARÍA AURELIA. Personalidad moral de Ameghino. Homenaje a Florentino Ameghino. Asoc. Cultural de Conferencias de Rosario, ciclo de caracter general 1936, publ. no. 2, pp. 25–29. 1937.

MOWBRAY, VINCENT. Low elevation records of the dusky shrew. Yosemite Nat. Notes, Yosemite, vol. 20, no. 3, pp. 23–24. March, 1941.

MURIE, ADOLPH. Ecology of the coyote in the Yellowstone. Fauna Nat. Parks U. S., Dept. Interior, Nat. Parks Serv., Bull. no. 4, pp. 1–149, figs. 56. 1940.

MURPHY, ROBERT CUSHMAN. Lo, the poor whale! Science, Lancaster, n. s., vol. 91, no. 2364, pp. 373–376. April 19, 1940.

NAUNOV, S. P. Parasitic invasions of *Lepus timidus* L. and their dependency of local conditions. Proc. Moscou Zool. Park, vol. 1, p. 201. 1940.

NECKER, WALTER L., and DONALD M. HATFIELD. Mammals of Illinois. Bull. Chicago Acad. Sci., Chicago, vol. 6, no. 3, pp. 17–60, figs. 15. 1941.

NEWMAN, BARCLAY MOON. Animal Methuselahs. Which animals live the longest? Scientific American, New York, vol. 164, no. 1, pp. 7–10. January, 1941.

NICHOLSON, ARNOLD J. The homes and social habits of the wood-mouse (*Peromyscus leucopus noveboracensis*) in southern Michigan. Amer. Midland Nat., Notre Dame, vol. 25, no. 1, pp. 196–223, figs. 3. January, 1941.

NORDQUIST, GUS. Elk teeth in California deer. California Fish and Game, San Francisco, vol. 27, no. 1, pp. 39–40. January, 1941. (*Odocoileus hemionus.*)

OLDHAM, FRANCES K. The development of the hypophysis of the armadillo. Amer. Jour. Anat., Philadelphia, vol. 68, no. 2, pp. 293–315, pls. 3, figs. 1–14. March 15, 1941.

OLIVKOV, B. M., and O. A. NOSSOVA. Cases of necrobacillosis in *Artiodactila* and *Macropus* in the Moscou Zoological Gardens. Proc. Moscou Zool. Park, vol. 1, pp. 322–335. 1940. (In Russian with a resumé in English.)

OLSON, HERMAN. Fur bearers of the Superior. Conserv. Volunteer, St. Paul, vol. 1, no. 5, pp. 37–39. February, 1941.

ORFORD, MARGARET. The rock engravings of the Western Transvaal. Trabalhos do 1° Congresso Nacional de Antropologia Colonial, Pôrto, vol. 2, pp. 463–497, figs. 14. 1934. (Mammals.)

ORLOV, J. A. Tertiary Carnivora of West Siberia. II. Melinae. Tertiary Mammalia and the localities of their remains. Trav. Inst. Paléont., Moscou and Leningrad, vol. 8, no. 3, pp. 5–29, figs. 17. 1941. (In Russian with English summary.)

——— Tertiary Carnivora of West Siberia. III. Mustelinae. Tertiary Mammalia and the localities of their remains. Trav. Inst. Paléont., Moscou and Leningrad, vol. 8, no. 3, pp. 30–39, figs. 8. 1931. (In Russian with English summary.)

——— Tertiary Carnivora of West Siberia. IV. Hyaeninae. Tertiary Mammalia and the localities of their remains. Trav. Inst. Paléont., Moscou and Leningrad, vol. 8, no. 3, pp. 40–59, pls. 1–5. 1941. (In Russian with English summary.)

——— Tertiary Carnivora of West Siberia. V. Ictitheriinae. Tertiary Mammalia and the localities of their remains. Trav. Inst. Paléont., Moscou and Leningrad, vol. 8, no. 3, pp. 61–85, pls. 2. 1941. (In Russian with English summary.)

——— Palaeontological expedition to Bedpak-Dala, 1936. Tertiary Mammalia and the localities of their remains. Trav. Inst. Paléont., Moscou and Leningrad, vol. 8, no. 3, pp. 87–98, figs. 9. 1941. (In Russian with English summary.)

——— A new locality of Hipparion-fauna at Djaparidze, East Georgia. Tertiary Mammalia and the localities of their remains. Trav. Inst. Paléont., Moscou and Leningrad, vol. 8, no. 3, pp. 99–101, figs. 2. 1941. (In Russian with English summary.)

OSBORN, FAIRFIELD. Scientific odyssey. A review of the work of the Zoological Society's department of tropical research. Bull. New York Zool. Soc., vol. 44, no. 1, pp. 3–16. January–February, 1941. (Photograph of mouse opossum and young; Guadalupe Id. sea elephants.)

OSGOOD, WILFRED H. New habitat group shows seals at "Uncle Sam's fur farm" in Alaska. Field Mus. News, Chicago, vol. 12, no. 1, pp. 1–2. January, 1941.

OTUKA, YANOSUKE. On the stratigraphic horizon of *Elephas* from Miyako Is., Ryūkyū Islands, Japan. Proc. Imperial Acad., Tokyo, vol. 17, no. 2, pp. 43–47, figs. 3. February, 1941.

PALMER, E. LAURENCE. Deserted deserts? Nature Mag., Washington, D. C., vol. 34, no. 2, pp. 85–92, illus. February, 1941.

PALMER, L. J. Animal and plant resources of Alaska. U. S. Dept. Interior, Fish and Wildlife Service, Wildlife leaflet 176, pp. 1–12. January, 1941.

PARSONS, R. E. Rivers as barriers to the distribution of gibbons. Jour. Bombay Nat. Hist. Soc., Bombay, vol. 42, no. 2, p. 434. April, 1941.

PATTERSON, EWEN K. Remarkable camel records. Our Dumb Animals, Norwood, vol. 74, no. 2, p. 25. February, 1941.

——— War on flying foxes. Game and Gun and the Angler's Monthly, London, vol. 18, no. 185, pp. 54–55. February, 1941.

PAULO COUTO, CARLOS DE. Os chiropteros fosseis do Brasil. Rev. Acad. Colombiano Cienc. Exactas, Fis. y. Nat. Corresp. de la Española, Bogotá, vol. 2, no. 7, pp. 464–465, fig. 1. August–October, 1938. (In Portuguese.)

——— Um grande elephante extincto: o mammuth. Rev. Acad. Colombiano Cienc. Exactas, Fis. y. Nat. Corresp. de la Española, Bogotá, vol. 2, no. 7, pp. 458–464, figs. 3. August–October, 1938. (In Portuguese.)

PEI, W. C. Note on a collection of mammal fossils from Tanyang in Kiangsu Province. Bull. Geol. Soc. China, Szechuan, vol. 19, no. 4, pp. 379–392, figs. 8. March, 1940.

PELANDOK. Seladang hunting in Pahang. Malayan Forester, Kuala Lumpur, vol. 7, no. 2, pp. 61–71, 7 figs. 1938. (Gaur.)

PENNER, LAWRENCE R. Parasitic problem. Zoonooz, Zool. Soc. San Diego, vol. 13, no. 2, p. 7. February, 1941.

PERRYGO, W. M. Collecting birds and mammals in South Carolina. Explor. and Field-work Smithsonian Inst. 1940, publ. no. 3631, pp. 27–30, illus. April 3, 1941.

PETRIDES, GEORGE A. How Yosemite squirrels spend the winter. Yosemite Nat. Notes, Yosemite, vol. 20, no. 1, pp. 1–3. January, 1941.

——— Notes on a large porcupine. Yosemite Nat. Notes, Yosemite, vol. 20, no. 3, pp. 20–21. March, 1941.

PETROV, A. M. Parasitic worms of Mustelidae of the Moscou Zoological Gardens. Proc. Moscou Zool. Park, vol. 1, pp. 202–231. 1940. (In Russian with a resumé in English.)

PHILLIPS, T. J. Vitality of a hyaena (*Hyaena striata*). Jour. Bombay Nat. Hist. Soc., Bombay, vol. 42, no. 2, p. 438. April, 1941.

PICKWELL, GAYLE. With the mule deer through the seasons. Audubon Mag., Harrisburg, vol. 43, no. 1, pp. 24–30, illus. January–February, 1941.

PIETERS, D. Something about elephants in Sumatra. Dutch East Indies, Departement van landbouw, nijverheid en handel (Nature Protection in the Netherlands Indies), Dept. Econ. Affairs, Batavia, pp. 53–54, illus. 1938. (A herd, varying in number from 14 to 100, occupies an area of 200 sq. km.; 2000 to 3000 elephants estimated to be present in Sumatra.)

PILGRIM, GUY E. The relationship of certain variant fossil types of "horn" to those of the living Pecora. Ann. and Mag. Nat. Hist., London, ser. 11, vol. 7, no. 38, pp. 172–184. February, 1941. (Skin-covered horn was probably the most primitive.)

——— The dispersal of the Artiodactyla. Biol. Reviews, Cambridge, vol. 16, no. 2, pp. 134–163. April, 1941.

PINTO, OLIVERIO. Da validez de *Cebus robustus* Kuhl e de suas relações com as formas mais afins. Papéis Avulsos Dept. Zool., Secretaria Agric., São Paulo, vol. 1, art. 15, pp. 111–120, figs. 4. March 11, 1941.

PLÁ, CORTÉS. Alocución preliminar. Homenaje a Florentino Ameghino. Asoc. Cultura, de Conferencias de Rosario, ciclo de caracter general 1936, publ. no. 2, pp. 15–22. 1937.

POLAK, B. Eugène Dubois. Natuurwetenschapp. Tijdschr. voor Nederlandsch Indië, Buitenzorg, vol. 101, no. 4, pp. 89–95. April 1, 1941.

PYCRAFT, W. P. The duck-billed platypus—a patchwork of past and present. Illus. London News, vol. 198, no. 5307, p. 30, figs. 3. January 4, 1941.

RAND, A. L., and L. J. BRASS. Results of the Archbold Expeditions. No. 29. Summary of the 1936–1937 New Guinea Expedition. Bull. Amer. Mus. Nat. Hist., New York, vol. 77, art. 7, pp. 341–380, pls. 21–42. November 29, 1940.

RAPPARD, IR. F. W., and A. HOOGERWERF. The game reserve South Sumatra I. Dutch East Indies, Departement van landbouw, nijverheid en handel (Nature Protection in the Netherlands Indies), Dept. Econ. Affairs, Batavia, pp. 49–52, illus. 1938.

RATCLIFFE, HERBERT L. New diets for the Zoo. Fauna, Philadelphia, vol. 2, no. 3, pp. 62–65. September, 1940.

REESE, ALBERT M. A cephalopagus lamb. Anat. Anz., Jena, vol. 89, nos. 1–4, pp. 20–25, figs. 3. October 16, 1939.

——— Predator control. Proc. W. Virginia Acad. Sci., Morgantown, vol. 14 [W. Virginia Univ. Bull. ser. 41, no. 4–II], pp. 21–26. October, 1940.

ROBERTS, THOMAS S. Itasca Park's pioneering beavers. Conserv. Volunteer, St. Paul, vol. 1, no. 6, pp. 37–40, illus. March, 1941.

ROCKWELL, ROBERT H. Too close to bears. Nat. Hist., New York, vol. 47, no. 3, pp. 136–138. March, 1941.

RUSCONI, CARLOS. Presentacion del nuevo Academico Dr. C. A. Marelli. Acad. Ciencias Buenos Aires, vol. 1, pp. 166–171. 1940.

RUTLEDGE, ARCHIBALD. The white-tailed deer. Fauna, Philadelphia, vol. 2, no. 3, pp. 55–58, illus. September, 1940.

SAKHAROVA, T. V. Anatomical structure of the cerebrum in Felis concolor. Proc. Moscou Zool. Park, vol. 1, pp. 64–69. 1940. (In Russian with a resumé in English.)

SCHAUB, S. Was ist *Felis elata* Bravard? Eclogae Geol. Helvetiae, Basel, vol. 32, no. 2, pp. 187–193. April 15, 1940.

SCHEFFER, THEO. H. Excavation of a runway of the pocket gopher (*Geomys bursarius*). Trans. Kansas Acad. Sci., Topeka, vol. 43, pp. 473–474, figs. 3. 1940.

SCHEPERS, G. W. H. Early phases in the development of the motor mechanisms of the South African baboon, *Papio porcarius*. S. African Jour. Sci., Johannesburg, vol. 37, pp. 228–238, figs. 2. February, 1941.

SCHMID, BASTIAN. Zur Psychologie des grossen Ameisenbären. Ist der Ameisenbär dumm? Die Umschau, Frankfurt am Main, Jahrg. 43, no. 36, pp. 836–839, figs. 7. September 3, 1939. (Giant anteater.)

SCHOTT, RALPH GEORGE, and RALPH WESLEY PHILLIPS. Rate of sperm travel and time of ovulation in sheep. Anat. Record, Philadelphia, vol. 79, no. 4, pp. 531–540, fig. 1. April 25, 1941.

SCHUENEMAN, ALBERT. I match wits with wolves. Alaska Sportsman, Ketchikan, vol. 7, no. 4, pp. 18–20. April, 1941.

SCHULTZ, ADOLPH H. Chevron bones in adult man. Amer. Jour. Phys. Anthrop., Philadelphia, vol. 28, no. 1, pp. 91–97. March 31, 1941.

——— The relative size of the cranial capacity in primates. Amer. Jour. Phys. Anthrop., Philadelphia, vol. 28, no. 3, pp. 273–287, figs. 3. September 30, 1941.

SCHULZ, N. G. Lungworms from *Ovis polii karelini* Blyth. Proc. Moscou Zool. Park, vol. 1, pp. 235–242. 1940. (In Russian with a resumé in English.)

SCHWARTZ, CHARLES W., and ELIZABETH R. SCHWARTZ. Opossum. Nature, Washington, D. C.; vol. 34, no. 3, pp. 149–150, 4 illus. March, 1941.

SCOFIELD, W. L. The sea otters of California did not reappear. California Fish and Game, San Francisco, vol. 27, no. 1, pp. 35–38. January, 1941.

Scott, W. E. Kettle eaten by porcupines. Wisconsin Conserv. Bull., Madison, vol. 6, no. 2, p. 38, illus. February, 1941.

Shaposhnikov, L. V. The *Capra falconeri* Wagn. of the Moscou Zoological Park. Proc. Moscou Zool. Park, vol. 1, pp. 62–63. 1940.

Shebbeare, E. O. An elephant catching syndicate. Jour. Bengal Nat. Hist. Soc., Darjeeling, vol. 15, no. 3, pp. 85–93, pls. 4–7, January, 1941; vol. 15, no. 4, pp. 120–125, pls. 3. April, 1941.

Shelford, V. E., and A. C. Twomey. Tundra animal communities in the vicinity of Churchill, Manitoba. Ecology, Brooklyn, vol. 22, no. 1, pp. 47–69. January, 1941.

Shelford, V. E. List of reserves that may serve as nature sanctuaries of national and international importance, in Canada, the United States, and Mexico. Ecology, Brooklyn, vol. 22, no. 1, pp. 100–110. January, 1941.

Shelly, Freeman M. Cage service. Fauna, Philadelphia, vol. 1, no. 3, pp. 46–50, illus. September, 1939.

Shillinger, J. E. Coccidiosis in muskrats influenced by water levels. Jour. Wildlife Management, Menasha, vol. 2, no. 4, pp. 233–234. October, 1938.

Shitkov, B. M. Some remarks on the Bokhara deer (*Cervus bactrianus* Lyd.). Proc. Moscou Zool. Park, vol. 1, pp. 50–58. 1940. (In Russian with a resumé in English.)

Silberberg, Martin, and Ruth Silberberg. Age changes of bones and joints in various strains of mice. Amer. Jour. Anat., Philadelphia, vol. 68, no. 1, pp. 69–95, 3 pls. January 15, 1941.

Simionescu, I., and Elena Dobrecu. Mamiferele Pliocene dela Cimişlia (Basarabia). V. Rumegătoarele. Acad. Română Publ. Fondului Vasile Adamachi, Bucureşti, vol. 9, no. 54, pp. 1–36, figs. 49, pls. 3. 1941.

Simpson, George Gaylord. How dost thou portray the Simurgh? Introducing the story of animal art through the ages. Nat. Hist., New York, vol. 47, no. 2, pp. 86–96, illus. February, 1941.

Singhji, His Highness Maharaj Rana Sir Rajender. The spotted deer. Indian Wild Life, Agra, vol. 5, pp. 3–7, photos. 2. October 29, 1940. (Chital—*Cervus axis*.)

Smith, Christianna, and Louise M. Ireland. Studies on the thymus of the mammal. I. The distribution of argyrophil fibers from birth through old age in the thymus of the mouse. Anat. Record, Philadelphia, vol. 79, no. 2 and suppl. no. 1, pp. 133–153, pls. 4. February, 1941.

Smith, Hugh M. The Uruguayan fur-seal islands. Zoologica, New York, vol. 9, no. 6, pp. 271–294, figs. 7. September 30, 1927.

Smith, Sedgwick E. Blood glucose, plasma inorganic phosphorus, plasma calcium, hematocrit, and bone ash values of normal minks (*Mustela vison*) and foxes (*Vulpes fulva*). Cornell Veterinarian, Ithaca, vol. 31, no. 1, pp. 56–62. January, 1941.

Sneider, Mary Elizabeth. Rhythms of ovogenesis before sexual maturity in the rat and cat. Amer. Jour. Anat., Philadelphia, vol. 67, no. 3, pp. 471–499, 4 pls. November 15, 1940.

Snyder, L. L. The mammals of Prince Edward County, Ontario. Univ. Toronto Studies, Biol. Ser. no. 48, pp. 12–24. 1941.

Soderwall, Arnold L., and William C. Young. The effect of aging in the female genital tract on the fertilizing capacity of guinea pig spermatozoa. Anat. Record, Philadelphia, vol. 78, no. 1, pp. 19–29. September 25, 1940.

Sowerby, Arthur de Carle. Some remarkable animals of China. Jour. N. China Branch Roy. Asiatic Soc., Shanghai, vol. 71, pp. 3–21, illus. 1940.

———— A further review of the mammals of China and Mongolia. China Jour., Shanghai, vol. 34, no. 1, pp. 26–37, illus. January, 1941.

Stefko, W. H. The illness of the chimpanzee "Bella". Proc. Moscou Zool. Park, vol. 1, pp. 277–284. 1940.

STEFKO, W. H., and A. A. KHARKOF. Comparative pathomorphology of the primary tubercular nidus in monkeys. Proc. Moscou Zool. Park, vol. 1, pp. 285–292. 1940. (In Russian with a resumé in English.)

STEFKO, W. H. Materials on comparative pathology of osseous tuberculosis in monkeys. Proc. Moscou Zool. Park, vol. 1, pp. 293–304. 1940. (In Russian with a resumé in English.)

STEHLIN, H. G. *Dicroceros elegans* Lartet und sein Geweihwechsel. Eclogae Geol. Helvetiae, Basel, vol. 32, no. 2, pp. 162–179, figs. 11. April 15, 1940.

STENDALL, J. A. SIDNEY. Pine marten in Co. Londonderry. Irish Nat. Jour., Belfast, vol. 7, no. 11, p. 314. March, 1941.

STOCK, CHESTER. (Review of) O. C. Marsh, Pioneer in Paleontology; by Charles Schuchert and Clara M. Le Vene, Yale Univ. Press, 1940. Amer. Jour. Sci., New Haven, vol. 239, no. 4, pp. 320–321. April, 1941.

STOTT, KEN, JR. Rodents: Native and foreign. Zoonooz, San Diego Zool. Soc., vol. 13, no. 1, pp. 6–7. January, 1941.

SURBER, T. How animal habitats have changed. Conserv. Volunteer, St. Paul, vol. 1, no. 6, pp. 4–9. March, 1941.

SVIHLA, ARTHUR. The relation of water to dormancy in mammals. Murrelet, Seattle, vol. 22, no. 1, pp. 15–18. January–April, 1941.

TAKAI, FUYUJI. Shansi mole-rat, *Myospalax fontanus* Thomas, found in the loess of Shansi Province, China. Japanese Jour. Geol. and Geogr. Trans. and Abstr., vol. 17, nos. 3 and 4, pp. 209–214, figs. 4, pl. 21. October, 1940.

TANNER, VASCO M. The flying squirrel collected in Garfield County, Utah. Great Basin Nat., Provo, vol. 1, nos. 3–4, p. 26. June 30, 1940. (*Glaucomys sabrinus lucifugus*.)

TATE, G. H. H. The mammals of the Guiana region. Bull. Amer. Mus. Nat. Hist., New York, vol. 76, art. 5, pp. 151–229. October 20, 1939.

——— Notes on the types of certain early described species of monotremes, marsupials, Muridae and bats from the Indo-Australian region. Amer. Mus. Novitates, New York, no. 1061, 10 pp. May 1, 1940.

——— Saa comes of age—Life story of a mandrill. Nat. Hist., New York, vol. 47, no. 2, pp. 70–72, fig. 1. February, 1941.

TATE, G. H. H. Results of the Archbold expeditions, No. 35. A review of the genus *Hipposideros* with special reference to Indo-Australian species. Bull. Amer. Mus. Nat. Hist., New York, vol. 78, art. 5, pp. 353–393, figs. 5. August 19, 1941. (New: *Hipposideros bicolor macrobullatus*, *H. breviceps*.)

——— Results of the Archbold expeditions, No. 36. Remarks on some Old World leaf-nosed bats. Amer. Mus. Novitates, New York, no. 1140, pp. 1–11. August 20, 1941. (New: *Aselliscus* for *Rhinolophus tricuspidatus* Temminck.)

TATE, G. H. H., and A. L. RAND. A new Galidia (Viverridae) from Madagascar. Amer. Mus. Novitates, New York, no. 1112, p. 1. May 19, 1941. (New: *Galidia elegans dambrensis*.)

TEALE, EDWIN. How bats "see" in the dark. After nearly 150 years of experimenting, science solves the riddle of night flying. Popular Sci. Monthly, New York, vol. 138, no. 3, pp. 102–104, figs. 7. March, 1941. (*Myotis* guided by echos from cries given off at 30± a second in sound wave band between 30,000 and 70,000 vibrations a second. Human top limit of audibility about 20,000.)

TELLER, WOOLSEY. Rimmer swallows whale story. Truth Seeker, New York, vol. 67, no. 11, pp. 169–171. November, 1940.

THOMPSON, RAYMOND. Trapping the Athabasca. Pt. 3. Fur-Fish-Game, Harding's Mag., Columbus, vol. 73, no. 1, pp. 10–12. January, 1941.

TOMILIN, MICHAEL I. Menstrual bleeding and genital swelling in *Miopithecus* (*Cercopithecus*) *talapoin*. Proc. Zool. Soc. London, ser. A, vol. 110, pp. 43–45, pl. 1. 1940.

TRIPPENSEE, R. E. A new type of bird and mammal marker. Jour. Wildlife Management, Menasha, vol. 5, no. 1, pp. 120–124, illus. January, 1941.

TROFIMOV, V. N. Parasitic worms of the urial (*Ovis vignei* Blyth) of the Moscou Zoological Gardens. Proc. Moscou Zool. Park, vol. 1, pp. 232–234. 1940. (In Russian with a resumé in English.)

TROUGHTON, ELLIS. Vampire bats. Australian Mus. Mag., Sydney, vol. 7, no. 7, pp. 244–248, figs. 3. December, 1940–February, 1941.

TRUEBLOOD, TED. The whiskery wood-rat. Nature, Washington, D. C., vol. 34, no. 3, pp. 151–152, 3 illus. March, 1941.

TSVETAEVA (ZWETAJEWA), N. P. Die Tierkrankheiten im Moskauer Zoologischen Garten. Proc. Moscou Zool. Park, vol. 2, pt. 2, 152 pp., 52 figs. 1941.

ULMER, FREDERICK A., JR. The living rhinoceroses. Fauna, Philadelphia, vol. 3, no. 1, pp. 2–11, illus. March, 1941.

VESEY-FITZGERALD, BRIAN. The noctule. Naturalist, London, no. 792, pp. 157–161, July, 1941; no. 793, pp. 189–198. August, 1941.

VILLA, BERNARDO. Nota acerca de algunas especies de roedores de los generos *Dipodomys*, *Perognathus* y *Peromyscus*. Anales Inst. Biol., Mexico City, vol. 12, no. 1, pp. 355–399, figs. A-F. 1941.

WAHNISH, ESTHER. Noticia preliminar sobre la revisión de la fauna marina del Postpampeano con una nota sobre el Querandino de General Lavalle y revisión de la especie "*Labiosa* (R.) *canaliculata*" Say. Physis (Rev. Soc. Argentina Cien. Nat.), Buenos Aires, vol. 14, no. 46, pp. 473–479. March 31, 1939.

WANGER, SENTA DE. Facts for chinchilla breeders—humidity. Amer. Fur Breeder, Duluth, vol. 13, no. 8, pp. 10–11, fig. 1, February, 1941.

WEBB, JOHN. Identification of rodents and rabbits by their fecal pellets. Trans. Kansas Acad. Sci., Topeka, vol. 43, pp. 479–481, fig. 1. 1940.

WEIDENREICH, FRANZ. The external tubercle of the human tuber calcanei. Amer. Jour. Phys. Anthrop., Philadelphia, vol. 26, pp. 473–486, figs. 9, pl. 1. March 30, 1940.

——— The torus occipitalis and related structures and their transformations in the course of human evolution. Bull. Geol. Soc. China, Peiping, vol. 19, no. 4, pp. 479–544, pls. 6. 1940.

WEIGELT, JOH. Die erste paleozäne Säugetierfauna aus deutschem Heimatboden. Die Umschau, Frankfurt am Main, Jahrg. 43, no. 43, pp. 954–957, figs. 8. October 22, 1939.

WELLS, L. J., and M. D. OVERHOLSER. Effects of estrogen on the genital tract and urethra of anestrous female ground squirrels. Anat. Record, Philadelphia, vol. 78, no. 1, pp. 43–57, 3 pls. September 25, 1940.

WHEELER, R. J., JR., and F. S. BARKALOW, JR. Black Warrior deer food. Alabama Conservation, Montgomery, pp. 1–3, fig. 1, photo. November, 1940.

WILLIAMS, R. R. Inefficacy of pantothenic acid against the graying of fur. Science, Lancaster, n. s., vol. 92, no. 2398, pp. 561–562. December 13, 1940.

WILLIAMS, WOODBRIDGE. Parky. The story of a young walrus who traveled farther south than his relatives in Bering Strait. Nat. Hist., New York, vol. 47, no. 1, pp. 42–45, figs. 7. January, 1941.

WISLOCKI, GEORGE B. Peculiarities of the cerebral blood vessels of the opossum: Diencephalon, area postrema and retina. Anat. Record, Philadelphia, vol. 78, no. 1, pp. 119–137, 3 pls. September 25, 1940.

WISLOCKI, GEORGE B., and ROBERT K. ENDERS. The placentation of the bottle-nosed porpoise (*Tursiops truncatus*). Amer. Jour. Anat., Philadelphia, vol. 68, no. 1, pp. 97–125, figs. 3, pls. 6. January 15, 1941.

WOLFE, ELWOOD. Deer attacks fox. Yosemite Nat. Notes, Yosemite, vol. 20, no. 3, p. 19. March, 1941.

ZIRKLE, CONWAY. Natural selection before the "origin of species". Proc. Amer. Philos. Soc., Philadelphia, vol. 84, no. 1, pp. 71–123. April 25, 1941.

ZVETAEVA, N. P. (see also, TSVETAEVA, N. P.) The pathology of the elephant "Djindau". Proc. Moscou Zool. Park, vol. 1, pp. 362–375. 1940. (In Russian with a resumé in English.)

OBITUARY NOTICE

WALTER GRANGER

Dr. Walter Granger, Curator of Fossil Mammals in the American Museum of Natural History, died of heart failure at Lusk, Wyoming, on September 6, 1941, at the age of 68 years. His unexpected passing is deeply mourned by all who knew him. He was friendly and generous, jovial yet dignified, an enthusiastic collector, and a wise councillor, full of that knowledge of natural history that comes of long and perceiving observation. Dr. Granger was born in Middletown Springs, Vermont, on November 7, 1872. In 1890 he came to the American Museum as an assistant in taxidermy. His first field work was in 1894 when he collected recent mammals and birds in the Big Badlands and Black Hills of South Dakota. The following year he returned to South Dakota and collected fossils as well, and in 1896 he became associated with the Department of Vertebrate Paleontology of the Museum. During the years that followed he collected from many fossil beds in the Western United States and in the Fayum region of Egypt. Later he penetrated the Gobi Desert as paleontologist of the American Museum Central Asiatic expeditions. He was an authority on Eocene mammals and stratigraphy. After over fifty years service to the American Museum, his end came while he was in the field. He was returning to the badlands of South Dakota to collect fossil mammals after attending the summer conference of the Society of Vertebrate Paleontology.—Joseph T. Gregory.

MALCOLM J. BRUMWELL

Lieut. Malcolm J. Brumwell was born at Sarles, North Dakota, August 1, 1911. He died at Hickam Field in Hawaii, December 14, 1941, of injuries received December 7 while in combat.

His boyhood days were spent on his father's ranch in North Dakota where his spare time was occupied with hunting and trapping. Because of the wholesale destruction of the breeding grounds of the ducks in his neighborhood, he determined to spend the rest of his life in the work of conservation of American wildlife.

After graduating from high school, he enlisted in the regular army and served three years, reaching the rank of Second Lieutenant, which rank he continued to hold as a Reserve Officer.

Lieut. Brumwell entered the University of Kansas in September, 1935, majoring in Vertebrate Zoology. He collected many specimens for the University museum as well as plants for the herberium, though most of his time in the field was spent with the camera, and in making studies of populations and habits of the vertebrates. He worked as an assistant in the Museum of Birds and Mammals under the direction of Mr. C. D. Bunker from the fall of 1938 until the fall of 1940, at which time he received an assistantship in the Zoology Department. He received his Master's Degree in the spring of 1941 from the University of Kansas. For the past three years he had carried on a scientific investigation of the vertebrates of the Fort Leavenworth Military Reservation, Leavenworth County, Kansas. The results of this ecological study are now in press.

In August, 1941, he was called back into active military duty.—Claude W. Hibbard.

COMMENT AND NEWS

TWENTY-FOURTH ANNUAL MEETING

The twenty-fourth annual stated meeting of the American Society of Mammalogists will be held concurrently with the twenty-fifth annual meeting of the American Society of Ichthyologists and Herpetologists at the American Museum of Natural History, New York, from Tuesday, March 31, to Saturday, April 4, 1942.

Titles for presentation at the meeting must be in the hands of the Corresponding Secretary, Emmet T. Hooper, Museum of Zoology, University of Michigan, Ann Arbor, Michigan, before March 1. Those submitting titles should include: (1) an abstract of the paper; (2) time required for presentation; and (3) projection apparatus needed.

Further details regarding the meeting may be obtained from the Corresponding Secretary or from the Local Committee on Arrangements: H. C. Raven, *Chairman*, Edwin H. Colbert, John Eric Hill and Claude Leister.

SURVEY OF NORTH AMERICAN MAMMAL COLLECTIONS

In order to promote the study of mammalogy and to encourage amateur collectors, A. Brazier Howell, some 17 years ago, published a Census of the Mammal Collections of North America (Jour. Mamm. vol. 4, no. 2, pp. 113–120, 1923). During the period that has elapsed since this publication many changes have taken place in these collections. Dr. Howell's list has proven to be so useful, however, that the American Society of Mammalogists has decided to revise it. It is the hope of the Society that every collection of mammals in North America may be included in the list. This will be difficult without the cooperation of everyone interested in the work. The Committee hopes, therefore, that each member of the Society will help by submitting the names and addresses of any local persons, colleges, organizations, or institutions having such a collection to: J. K. Doutt, Carnegie Museum, Pittsburgh, Pennsylvania.

If you have a collection of your own or are in charge of a mammal collection will you please fill out the questionnaire on the opposite page of this Journal and mail it to the above address.

PROPOSED AMENDMENTS TO THE BY-LAWS

The Board of Directors of the Society recommend that parts of Article VIII of the By-Laws be amended as follows:

Section 1, which states "Annual dues for members shall be three dollars, payable in advance," be amended to read "Each member of the Society shall pay dues of $3.50 for each calendar year, or portion thereof, of his membership; provided, however, that if payment for such year shall be made on or before January 10 thereof or (in the case of a member who shall have been admitted to membership during such year) on or before the date of his admission, an allowance of $.50 on the dues for such year shall be made."

Section 2, which states "Any member upon payment of seventy-five dollars at one time shall be entitled to life membership, and shall be exempt from membership dues," be changed to read "Any member upon payment of $75.00 to the Society at any one time, or in not to exceed five installments over a period of eighteen months, shall be entitled to Life Membership and shall be exempt from membership dues after such payment is made in full."

The Society will consider adoption of these amendments at the twenty-fourth annual meeting, to be held in New York City, March 31 to April 4, 1942.